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ABSTRACT

The purpose of this project is to help teachers of mathematics get started using the computer to aid the teaching and learning of many mathematical concepts in a meaningful way. To this end, commercially available software packages are described which are versatile, cost effective, and easy to use. A review and several lessons, including homework exercises, have been written for each package and are presented in ready-to-use form. Chapter 1, "Polynomial Practice Using Tiles: Discovering Algebra" (Sunburst), includes three lessons about modeling and addition. Chapter 2, "Interpreting Graphs" (Sunburst/Conduit), presents a lesson about the relationship between graphs and events. Chapter 3, "The Geometric preSupposer" (Sunburst), provides five lessons about angles, right triangles, quadrilaterals, and segments. Chapter 4, "Geometric Supposer: Quadrilaterals" (Sunburst), offers three lessons about parallelograms and the trapezoid. Chapter 5 "Superplot" (EduSoft), is a lesson about graphing inverse functions. Chapter 6, "Introductory Statistics Software Package" (Addison-Wesley), contains four lessons about mean, standard deviation, distribution, sampling and correlation. The last chapter, "The Whatsit Corporation: Survival Math Skills" (Sunburst), has five lessons about predictions of impact of price, sales tax, and simulation. (YP)

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PROJECT TO INCREASE MASTERY OF MATHEMATICS AND SCIENCE

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A REVIEW
OF
SELECTED MICROCOMPUTER SOFTWARE PACKAGES
WITH LESSONS
FOR TEACHING MATHEMATICS
GRADES 8 - 12

VOLUME 2

A Curriculum Development Project
of the
Project to Increase Mastery of Mathematics and Science

SE 050 770

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APRIL 1988

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A REVIEW

OF

SELECTED MICROCOMPUTER SOFTWARE PACKAGES

WITH LESSONS

FOR TEACHING MATHEMATICS

GRADES 8 - 12

A Curriculum Development Project

of the

Project to Increase Mastery of Mathematics and Science

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APRIL 1988

HISTORY, GOALS, AND SUPPORT OF **pimms**

The Project to Increase Mastery of Mathematics (**pimm**) began in 1979 as a joint effort of a diverse group of volunteers--individuals from education, business, government, industry, and labor--to foster greater command, understanding, and appreciation of mathematics by graduates of Connecticut schools. The symbiotic relationship of mathematics and its applications was a pervasive theme of the various **pimm** undertakings.

In 1983, the organization broadened its scope to become the Project to Increase Mastery of Mathematics and Science (**pimms**), and at the same time expanded its activities by mounting a Fellowship Program: notably able Connecticut high school teachers of mathematics and science were invited to study together at Wesleyan in courses and seminars as a prelude to offering consultative assistance on curricular matters to schools requesting such service and to providing workshops to teachers for their professional development.

Several groups of Fellows are devoting the bulk of their energies to writing projects. The materials they prepare will be broadly disseminated to facilitate the introduction into school curricula of mathematical applications of major importance and considerable attractiveness.

Now several Fellowship Programs are in operation, extending the concept to middle school and elementary school teachers. A significant value of the Fellowship Programs is found in the colleagueship developed among professionals working in different institutions at varied levels.

Throughout its growth, **pimms** has continued as a partnership of individuals and organizations. The list of devoted volunteers is too long to be recorded here. Major financial support of **pimms** has been supplied by the Connecticut Department of Education, the Connecticut Department of Higher Education, the Charles E. Culpeper Foundation, the General Electric Foundation, GTE, Divisions of United Technologies Corporation (Hamilton Standard, Norden Systems, Otis Elevator, Pratt and Whitney Manufacturing, Research Center, Sikorsky Aircraft), and Wesleyan University. Substantial contributions have also been made by Amax Foundation, Army Research Office, Boehringer Ingelheim, Chesebrough-Ponds, Choate Rosemary Hall, CIGNA, Connecticut Academy of Science and Engineering, General Signal, the Edward W. Hazen Foundation, Northeast Utilities, Omega Group, The Perkin-Elmer Corporation, Pfizer Inc., Pitney Bowes, Raymond Engineering, SNET, Stanley Works, Union Carbide Corporation, and Xerox Corporation.

All of us who are concerned for high quality education owe a great debt of gratitude to these organizations for their corporate citizenship.

R. A. Rosenbaum
Director, **pimms**

FOREWORD

In the report, How Schools Use Microcomputers, Henry Jay Becker stated, ". . . with an organized and sustained strategy for using computers to improve the effectiveness of school instruction we might accomplish what has eluded education throughout recent decades -- clear and obvious improvements in student accomplishment and in how much learning occurs in a day in school. Nothing would help the institution or its practitioners more." *

The preparation of this second volume, and subsequent annual volumes, is a step towards the realization of that goal.

Connecticut school districts may contact the **pimms** office for information on scheduling an Awareness Workshop or other in-service program related to the use of computers for mathematics instruction.

We earnestly solicit the comments of users of this material. Please send your suggestions for improvements, reviews, or lessons to

Ann Duffy
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Middletown, CT 06457

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*Becker, Henry Jay, How Schools Use Microcomputers: Summary of the 1983 National Survey, The Johns Hopkins University Center of Social Organization of Schools; Baltimore, 1985.

CONTENTS

INTRODUCTION

A REVIEW - POLYNOMIAL PRACTICE USING TILES: DISCOVERING ALGEBRA (Sunburst) 1

- Lesson 1 - Modeling Polynomials 3
- Lesson 2 - Addition of Polynomials using Tiles - Day 1 9
- Lesson 3 - Addition of Polynomials using Tiles - Day 2 16

A REVIEW - INTERPRETING GRAPHS (Sunburst/Conduit) 23

- Lesson 1 - Relating Graphs to Events 25

A REVIEW - THE GEOMETRIC preSUPPOSER (Sunburst) 32

- Lesson 1 - Angles Formed with Parallel Lines and Transversals 33
- Lesson 2 - Right Triangles 38
- Lesson 3 - Segments and Areas of Quadrilaterals 45
- Lesson 4 - Special Segments in a Triangle 51
- Lesson 5 - Segment Parallel to a Side of a Triangle 58

A REVIEW - THE GEOMETRIC SUPPOSER: QUADRILATERALS (Sunburst) 63

- Lesson 1 - Properties of Parallelograms 65
- Lesson 2 - Diagonals of Parallelograms 74
- Lesson 3 - Medians of a Trapezoid 84

A REVIEW - SUPERPLOT (EduSoft) 91

- Lesson 1 - Graphing Inverse Functions 93

A REVIEW - INTRODUCTORY STATISTICS SOFTWARE PACKAGE (Addison-Wesley) 102

Lesson 1 - Mean, Variance, Standard Deviation 103

Lesson 2 - Distribution Shapes 108

Lesson 3 - Sampling from a Population 114

Lesson 4 - Correlation 120

A REVIEW - THE WHATSIT CORPORATION : SURVIVAL MATH SKILLS (Sunburst) 127

Lesson 1 - The Effect of Price on Sales 129

Lesson 2 - The Effect of Price on Income 138

Lesson 3 - The Effect of Advertising on Sales 145

Lesson 4 - Sales Tax 155

Lesson 5 - Running the Simulation 162

pimms Computer Awareness Workshop Flyer inside Back Cover
pimms Curriculum Development Publications Back Cover

COMPUTER SOFTWARE PROGRAM REVIEW AND DESCRIPTION

TITLE: **POLYNOMIAL PRACTICE USING TILES: DISCOVERING ALGEBRA**
PUBLISHER: Sunburst Communications
ADDRESS: 39 Washington Ave.
Pleasantville, NY 10570
(800)431-1934
PRICE: $65.00
10-disk lab pack $195.00
COMPUTER: Apple IIe
PIMMS' RATING: good

PROGRAM IS APPROPRIATE FOR

Courses: Pre-algebra, Algebra
(or any applied math course with an algebra component)

Ability level: low to high

Format: classroom demo/lab

CHARACTERISTICS: disk -dependent
(The diskette must be in the computer to move from one program to another, but single programs are not disk-dependent.)

ADDITIONAL PERIPHERALS NEEDED: color monitor preferred

REVIEW AND DESCRIPTION OF THE PROGRAM

The diagrammatic features of this package make it especially useful for concept introduction with slower students and for concept reinforcement with average students.

Polynomial Practice Using Tiles provides a pictorial representation for second degree polynomials (third degree in accompanying printed material) and computations involving those polynomials. A square tile represents x^2 (dimensions x by x), a rectangle represents x (dimensions 1 by x), and a small square represents 1 (dimensions 1 by 1). The negatives of these values are represented by color-shaded versions of the corresponding shapes. These pictorial representations model the concrete projectuals/manipulatives package "Algebra Tiles", available singly or in student packs from several vendors such as Cuisenaire Company of America or Edusoft.

The graphics are slow to appear on the screen, but students may use this time to count the representations as they appear. A summary of each student's responses is provided at the end of each lesson. The supporting material in the Sunburst package provides specific directions for symbol entry. Reprint masters are provided for the algebra tiles so that the teacher may have the students manipulate the tiles individually (concrete stage) before moving to the pictorial stage employed in the software.

Available options include:

- identifying collections (naming polynomials from pictures) which may include up to 20 randomly-generated problems involving only positive coefficients, only negative coefficients, or a mixture of both.

- addition of polynomials. (Given the pictures of two collections of algebra tiles, the student counts from the screen and enters responses for addends and sum.) Coefficient options are as above.

- subtraction of polynomials. (We do not recommend addressing this unit. Subtraction using tiles is dealt with much more comprehensively in the Cuisenaire booklet accompanying "Algebra Tiles for the Overhead Projector".)

- multiplication of polynomials (provides practice with multiplying a monomial constant by a monomial, a monomial constant by a binomial, a monomial constant by a trinomial, and two binomials). Under the last option, the student is shown the tiles in a rectangular format and is asked to identify the horizontal dimension (such as $3x + 2$), the vertical dimension (such as $x + 1$), and the product $(3x^2 +5x +2)$.

[This unit is particularly useful for laying the foundation for factoring trinomials. The major drawback is that it does not provide for negative values.]

- division of polynomials (somewhat limiting because of emphasis on "division" rather than on factoring). Provision for teacher-designed worksheets helps compensate for this shortcoming in the program.

Twelve worksheets (with answers) are provided in the Sunburst booklet; however, a much more detailed and varied description of the use of tiles is given in the Cuisenaire booklet -- especially as their use relates to working with negative values such as $(2x - 1)(x + 2)$ or $(5x^2 -7x +2) - (-2x^2 + 4x -1)$.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: MODELING POLYNOMIALS

OBJECTIVES:

- identify the pieces in a collection of algebra tiles
- given a tiles model, name the polynomial modeled
- given a polynomial, make a model using tiles

COURSES: Pre-algebra, Algebra 1

SOFTWARE PACKAGE NEEDED:

Polynomial Practice Using Tiles: Discovering Algebra

OTHER MATERIALS:

- algebra tiles (or facsimile paper tiles) for the overhead projector

SUGGESTED TIME: 1 class period

PREREQUISITE SKILLS/CONCEPTS:

- familiarity with the structure of second degree algebraic polynomials

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LAB ACTIVITY

MODELING POLYNOMIALS
LABORATORY ACTIVITY
TEACHER'S GUIDE

Teacher-Student Dialogue (appromixately 15-20 minutes)

1) Teacher: Using your algebra tiles show us the tile which is closest to one square centimeter in area.
(The student should display the small square.)

2) Teacher (holding up the large square): If the length of one side of this square is x, write down the area of this square.
(Teacher circulates to check responses: x^2)

3) Teacher: Can you find another algebra tile which also has a side of length x? of width 1? Give the area of that tile. (tile: ▭ area: x)

4) Teacher: If the blank (paper) or colored tiles represent positive values of x^2, x, or 1, what should the shaded (paper) or black tiles represent? (negative values)

5) The teacher places several tiles of different sizes and colors (x^2, $-x^2$, x, -x, 1, -1) on the overhead projector and asks the student to identify those models that are "like" models.

6) Teacher: Use your tiles. Model the monomial.

a) $4x^2$	b) 3	c) -4x
d) 6x	e) $-2x^2$	f) -5

(The teacher circulates to check for understanding.)

7) The teacher places positive algebra tiles on the overhead projector to model:
    a constant
    a monomial in x
    a monomial in x^2
    a binomial in x
    a trinomial

Teacher: "Write the polynomial for each model."

8) The teacher places negative algebra tiles on the overhead projector to model:
    a constant
    a monomial in x
    a monomial in x^2
    a binomial in x
    a trinomial

Teacher: "Write the polynomial for each model."

Computer Activity
(approximately 20 minutes)

Ideally, the program **Polynomial Practice Using Tiles: Discovering Algebra** should be loaded prior to sending students to the computers. A lab pack is most convenient for this purpose.

(The diskette must be in the disk drive to permit the user to move among the three sections of the "Identify Collections" option.)

Students should be warned not to exit the program, but to call the teacher when a lesson has been completed. Also, they should NOT press RETURN once their results have been displayed on the screen. Students should record their results on the issued Student Record Sheets.

Students should do ten exercises from each section to reinforce the identification of polynomials from pictorial models.

MODELING POLYNOMIALS
LABORATORY EXERCISES
STUDENT RECORD SHEET

TILES ACTIVITY

1. Write the polynomial representation for each model the teacher displays.

a)

b)

c)

d)

e)

COMPUTER ACTIVITY

2. As directed by your teacher, run the Polynomial Practice Using Tiles Program and select Option 2 -- Identifying Collections. Do ten exercises from each section.

3. Record of Results (Record the results of your computer practice sessions as they appear on the computer screen.)

Polynomials with Positive Coefficients:

a) Number correct on Try 1: ___ b) on Try 2: ___

Polynomials with Negative Coefficients:

c) Number correct on Try 1: ___ d) on Try 2: ___

Polynomials with a Mixture of Positive and Negative Coefficients:

e) Number correct on Try 1: ___ f) on Try 2: ___

MODELING POLYNOMIALS
HOMEWORK EXERCISES

1. Draw a model for the polynomial expression.

a) 3 b) -4 c) $5x$

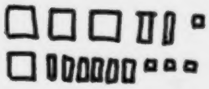
d) $-4x$ e) $2x^2$ f) $-6x^2$

g) $x + 2$ h) $2x + 1$ i) $x - 3$

j) $-3x + 1$ k) $-4x - 5$ l) $x^2 - 1$

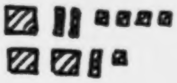
m) $2x^2 + 3$ n) $-x^2 + x + 1$ o) $4x^2 - 3x - 5$

2. Give the number of x^2's, x's, or 1's represented by the model.



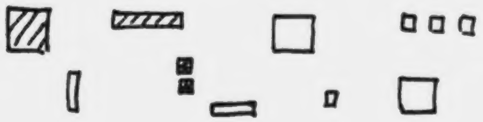
____ x^2 ____ x ___ 1

3. Give the number of $-x^2$'s, $-x$'s, or -1's represented by the model.



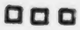
____ $-x^2$ ____ $-x$ ___ -1

4. Circle those models which represent like terms.

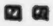


5. Write the polynomial which the model represents.

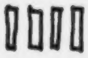
a)



b)



c)



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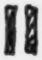

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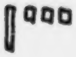
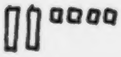
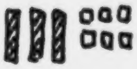


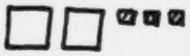
f)



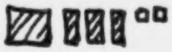
g)



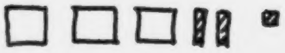
h)



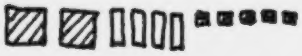
i)



j)

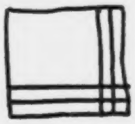


k)



6. Give the area of the figure.

a)



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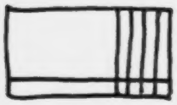
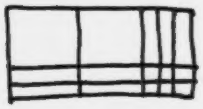


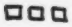
c)



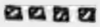
MODELING POLYNOMIALS
HOMEWORK EXERCISES
ANSWERS

1. Draw a model for the polynomial expression.

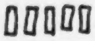
a) 3



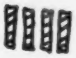
b) -4



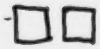
c) $5x$



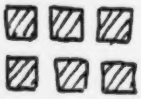
d) $-4x$



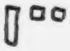
e) $2x^2$



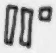
f) $-6x^2$



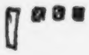
g) $x + 2$



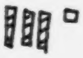
h) $2x + 1$



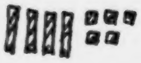
i) $x - 3$



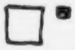
j) $-3x + 1$



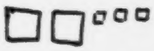
k) $-4x - 5$



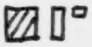
l) $x^2 - 1$



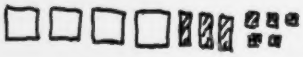
m) $2x^2 + 3$



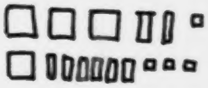
n) $-x^2 + x + 1$



o) $4x^2 - 3x - 5$

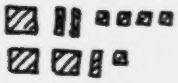


2. Give the number of x^2's, x's, or 1's represented by the model.



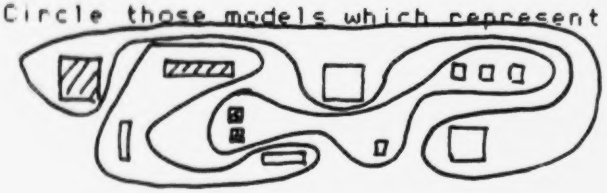
4 x^2 8 x 4 1

3. Give the number of $-x^2$'s, $-x$'s, or -1's represented by the model.

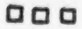


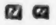
3 $-x^2$ 3 $-x$ 5 -1

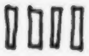
4. Circle those models which represent like terms.

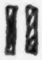


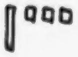
5. Write the polynomial which the model represents.

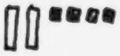
a)  3

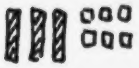
b)  -2

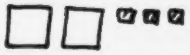
c)  4x

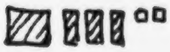
d)  -2x

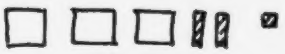
e)  x+3

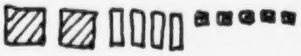
f)  2x-4

g)  $-3x+6$

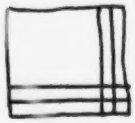
h)  $2x^2-3$

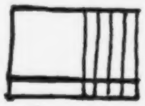
i)  $-x^2-3x+2$

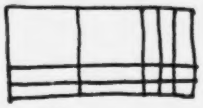
j)  $3x^2-2x-1$

k)  $-2x^2+4x-5$

6. Give the area of the figure.

a)  x^2+4x+4

b)  x^2+5x+4

c)  $2x^2+7x+6$

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: ADDITION OF POLYNOMIALS USING TILES

OBJECTIVES:

- to find the sum of polynomials using algebra tiles
- to find the sum of polynomials from a pictorial representation
- to thereby improve the skills and concepts used to find sums of polynomials given in algebraic symbols

COURSES: Pre-Algebra, Algebra I, Unified Math I

SOFTWARE NEEDED:

Polynomial Practice Using Tiles: Discovering Algebra

OTHER MATERIALS:

- algebra tiles or paper models of algebra tiles
- algebra tiles for the overhead projector

SUGGESTED TIME: 2 class periods

PREREQUISITE SKILLS/CONCEPTS:

- understand how to work with algebra tiles
- know how to name polynomials from the tiles or from a representation of the tiles
- understand the terminology of polynomials including: lead coefficient, coefficient of the linear term, constant
- understand the meaning of like terms and be able to identify tiles which represent "like terms"
- know how to use the Polynomial Practice Using Tiles program
- understand the concept of additive inverse
- understand that a blank (colored) tile and a shaded (black) tile are additive inverses with zero sum

FORMAT: discussion/laboratory

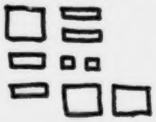
GENERAL DESCRIPTION OF THE LAB ACTIVITY

ADDITION OF POLYNOMIALS USING TILES - Day 1
LABORATORY EXERCISES
TEACHER'S GUIDE

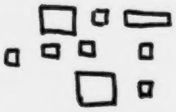
TEACHER-DIRECTED DISCUSSION (approximately 10 minutes)

Randomly place two collections of positive algebra tiles on the overhead projector and ask students first to model each collection using their own tiles and then to name the polynomial represented by each collection.

Examples:



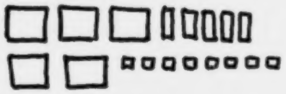
$3x^2 + 4x + 2$



$2x^2 + x + 6$

Ask students to gather together all like tiles and record the name of the polynomial given by combing the collections.

Example:



5x2 + 5x + 8

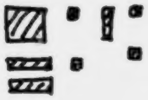
Ask what operation is indicated by the gathering together of both collections. (addition)

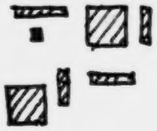
Then exhibit via chalkboard or overhead projector:

$$\begin{array}{rr} & 3x^2 + 4x + 2 \\ + & 2x^2 + x + 6 \\ \hline & 5x^2 + 5x + 8 \end{array}$$

Next, randomly place two collections of negative algebra tiles on the overhead projector and ask students first to model the two collections and then to name the polynomial represented by each collection.

Examples:

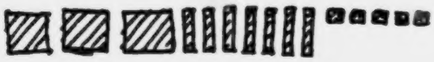




Ans. $-x^2 - 3x - 4$
Ans. $-2x^2 - 4x - 1$

Ask students to gather together all like tiles and to record the polynomial represented by combining the two collections.

Example:



Ans. $-3x^2 - 7x - 5$

Ask what operation is indicated by the gathering together of both collections. (addition) Be sure that students understand that even though they are working with negative coefficients, the combining process represents addition, not subtraction.

Next, exhibit via chalkboard or overhead projector:

$$\begin{array}{rr} & -x^2 - 3x - 4 \\ + & -2x^2 - 4x - 1 \\ \hline & -3x^2 - 7x - 5 \end{array}$$

TILES ACTIVITY (small groups, appx. 10 minutes)

Students should be grouped in pairs. One student creates two collections with positive tiles. The other should:

- identify the polynomial represented by each collection
- gather together the like terms of both collections
- name the polynomial represented by this total collection
- write the sum of the two polynomials using algebraic symbols.

The students then exchange roles. (During this activity the teacher circulates around the room to ask students to describe what they are doing.)

In the next round students should be asked to create collections using negative tiles, then to repeat the above activity.

COMPUTER ACTIVITY (10-15 minutes)

Finally, have students move in pairs to computers where the program Polynomial Practice Using Tiles already has been loaded and the "Addition of Polynomials" option already selected. Students should be directed to choose #1 (problems with only positive coefficients) and to select five items. Students should record the results of this work, then move to #2 (problems with only negative coefficients) and select five items. Students should record these results and submit their record sheets.

The teacher moves about the room to assure that each student interacts with the program.

ADDITION OF POLYNOMIALS USING TILES - DAY 1
LABORATORY EXERCISES
STUDENT RECORD SHEET

TILES ACTIVITY
Classroom Examples:

EXERCISES:

1) Working in pairs, one team member should create two collections with positive tiles. The partner should:

a) Identify the polynomial given by each collection and record the results. ____________________

____

b) Gather together the like terms of both collections and record the name of the polynomial represented by this total.

____

c) Write the sum of the two polynomials using algebraic symbols.

polynomial 1 ____________________

+ polynomial 2 + ____________________

sum ____________________

2) Now switch roles and repeat the steps in 1.

a) Identify the polynomial given by each collection.

____

____

b) Gather together the like terms of both collections and name the polynomial represented by this total.

____

c) Write the two polynomials and their sum in algebraic symbols.

polynomial 1 ____________________

+ polynomial 2 + ____________________

sum ____________________

3) Now create two collections using negative tiles. Your partner should:

a) Identify the polynomial given by each collection and record the results.

____

____

b) Gather together the like terms of both collections. Record the name of the polynomial represented by this total.

____

c) Write the two polynomials and their sum in algebraic symbols.

polynomial 1 ________________________

+ polynomial 2 + ________________________

sum ________________________

4) Now switch roles again. One person should form two collections using negative tiles. The partner should:

a) Identify the polynomial given by each collection. Record results.

____

____

b) Gather together the like terms of both collections. record the name of the polynomial represented by this total.

____

c) Write each of the two polynomials and their sum. Use algebraic symbols.

polynomial 1 ________________________

+ polynomial 2 + ________________________

sum ________________________

COMPUTER ACTIVITY

5. Use the TILES program. Choose the Addition of Polynomials option as directed by your teacher. From its menu choose #1 and do two tries of 5 exercises each; then choose #2, and do likewise.

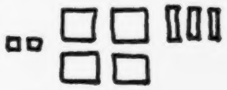
6. Computer Practice Record of Results

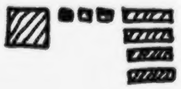
Polynomials with only positive coefficients:
a) Number correct on Try 1: ____ b) on Try 2: ____

Polynomials with only negative coefficients:
c) Number correct on Try 1: ____ d) on Try 2: ____

ADDITION OF POLYNOMIALS - Day 1
HOMEWORK EXERCISES

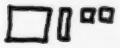
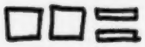
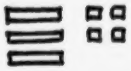
1. Give the polynomial represented by the collection of tiles. (Blank tiles are positive; shaded tiles, negative.)

a) 

b) 

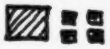
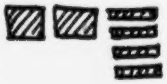
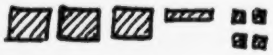
________ ________

2. Give the polynomial represented by each collection of tiles and the polynomial sum represented by the combined collections of tiles.

a)   

________ ________ ________

Sum ________

b)   

________ ________ ________

Sum ________

3. Represent the two polynomials and their sum by drawing pictures of tiles.

a)
$$\begin{array}{r} x^2 + 2x + 3 \\ + \quad 2x^2 + x + 1 \\ \hline 3x^2 + 3x + 4 \end{array}$$

b)
$$\begin{array}{r} -2x^2 - 2x - 1 \\ -3x^2 - x - 2 \\ \hline -5x^2 - 3x - 3 \end{array}$$

4. Add. (You may use algebra tiles if necessary.)

a)
$$\begin{array}{rcrcr} 4x^2 & + & 3x & + & 2 \\ x^2 & + & x & + & 4 \\ \hline \end{array}$$

b)
$$\begin{array}{rcrcr} x^2 & + & 5x & + & 6 \\ 5x^2 & & & + & 3 \\ \hline \end{array}$$

c)
$$\begin{array}{rcrcr} x^2 & + & 4x & & \\ x^2 & + & 3x & + & 1 \\ \hline \end{array}$$

d)
$$\begin{array}{rcrcr} & & x & + & 3 \\ x^2 & + & 2x & + & 1 \\ 2x^2 & + & x & & \\ \hline \end{array}$$

e)
$$\begin{array}{rcrcr} 4x^2 & & & + & 4 \\ & & 5x & + & 1 \\ 3x^2 & + & 4x & + & 2 \\ \hline \end{array}$$

5. Add.

a)
$$\begin{array}{rcrcr} -x^2 & - & 2x & - & 1 \\ -3x^2 & - & 5x & - & 2 \\ \hline \end{array}$$

b)
$$\begin{array}{rcrcr} -2x^2 & - & 4x & - & 3 \\ -5x^2 & - & x & - & 1 \\ \hline \end{array}$$

c)
$$\begin{array}{rcrcr} -x^2 & & & - & 1 \\ -x^2 & - & 2x & & \\ \hline \end{array}$$

d)
$$\begin{array}{rcrcr} -5x^2 & - & x & - & 3 \\ -x^2 & & & - & 5 \\ & - & x & - & 4 \\ \hline \end{array}$$

e)
$$\begin{array}{rcrcr} & - & x & - & 2 \\ -x^2 & & & - & 3 \\ -2x^2 & - & 4x & - & 1 \\ \hline \end{array}$$

6. Add.

a) $(2x^2 + 4x + 1) + (6x^2 + 2x + 7)$

b) $(7x^2 + x + 3) + (x^2 + 4x + 2)$

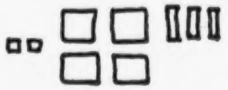
c) $(-x^2 - 2x - 2) + (-3x^2 - 3x - 4)$

d) $(-5x^2 - x - 7) + (-2x^2 - 5x - 9)$

ADDITION OF POLYNOMIALS - Day 1
HOMEWORK EXERCISES

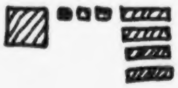
1. Give the polynomial represented by the collection of tiles. (Blank tiles are positive; shaded tiles, negative.)

a)



$4x^2 + 3x + 2$

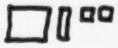
b)

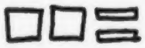


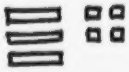
$-x^2 - 4x - 3$

2. Give the polynomial represented by each collection of tiles and the polynomial sum represented by the combined collections of tiles.

a)



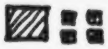


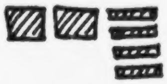


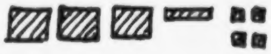
$x^2 + x + 2$ $2x^2 + 2x$ $3x + 4$

Sum $3x^2 + 6x + 6$

b)







$-x - 4$ $-2x^2 - 4x$ $-3x^2 - x - 1$

Sum $-5x^2 - 6x - 8$

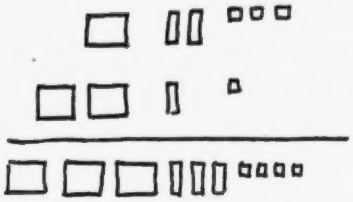
3. Represent the two polynomials and their sum by drawing pictures of tiles.

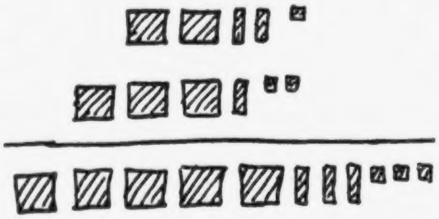
a)

$$\begin{array}{rrrr} & x^2 + & 2x + & 3 \\ + & 2x^2 + & x + & 1 \\ \hline & 3x^2 + & 3x + & 4 \end{array}$$

b)

$$\begin{array}{rrr} -2x^2 - & 2x - & 1 \\ -3x^2 - & x - & 2 \\ \hline -5x^2 - & 3x - & 3 \end{array}$$





4. Add. (You may use algebra tiles if necessary.)

a)
$$\begin{array}{r} 4x^2 + 3x + 2 \\ x^2 + x + 4 \\ \hline 5x^2 + 4x + 6 \end{array}$$

b)
$$\begin{array}{r} x^2 + 5x + 6 \\ 5x^2 \qquad + 3 \\ \hline 6x^2 + 5x + 9 \end{array}$$

c)
$$\begin{array}{r} x^2 + 4x \qquad \\ x^2 + 3x + 1 \\ \hline 2x^2 + 7x + 1 \end{array}$$

d)
$$\begin{array}{r} x + 3 \\ x^2 + 2x + 1 \\ 2x^2 + x \qquad \\ \hline 3x^2 + 4x + 4 \end{array}$$

e)
$$\begin{array}{r} 4x^2 \qquad + 4 \\ 5x + 1 \\ 3x^2 + 4x + 2 \\ \hline 7x^2 + 9x + 7 \end{array}$$

5. Add.

a)
$$\begin{array}{r} -x^2 - 2x - 1 \\ -3x^2 - 5x - 2 \\ \hline -4x^2 - 7x - 3 \end{array}$$

b)
$$\begin{array}{r} -2x^2 - 4x - 3 \\ -5x^2 - x - 1 \\ \hline -7x^2 - 5x - 4 \end{array}$$

c)
$$\begin{array}{r} -x^2 \qquad - 1 \\ -x^2 - 2x \qquad \\ \hline -2x^2 - 2x - 1 \end{array}$$

d)
$$\begin{array}{r} -5x^2 - x - 3 \\ -x^2 \qquad - 5 \\ - x - 4 \\ \hline -6x^2 - 2x - 12 \end{array}$$

e)
$$\begin{array}{r} - x - 2 \\ -x^2 \qquad - 3 \\ -2x^2 - 4x - 1 \\ \hline -3x^2 - 5x - 6 \end{array}$$

6. Add.

a) $(2x^2 + 4x + 1) + (6x^2 + 2x + 7) = 8x^2 + 8x + 8$

b) $(7x^2 + x + 3) + (x^2 + 4x + 2) = 8x^2 + 5x + 5$

c) $(-x^2 - 2x - 2) + (-3x^2 - 3x - 4) = -4x^2 - 5x - 6$

d) $(-5x^2 - x - 7) + (-2x^2 - 5x - 9) = -7x^2 - 6x - 16$

ADDITION OF POLYNOMIALS USING TILES - Day 2
LABORATORY EXERCISES
TEACHER'S GUIDE

TEACHER-DIRECTED DISCUSSION

Review of Homework (approximately 5 minutes)

It is recommended that the teacher make an overhead transparency of the solution key for the homework exercises in Lesson 1 (addition of polynomials) and display it as students enter the classroom. Students can be asked to work in pairs to check their work, can be sent to the board to work on any exercises they had difficulty with, can be asked to do a few similar problems, or can be asked to design other exercises having solutions similar to those in the assigned homework. The teacher should circulate to check progress.

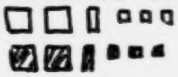
Introducing the Zero Principle
(approximately 15 - 20 minutes)

The teacher places both positive and negative small squares on the overhead projector and asks students to name their values (1 and -1) and to name the similarities (same dimensions) and the differences (different colors imply opposite signs). Next, the teacher groups the tiles and asks students to suggest a value for the model created when a positive tile and a negative tile having the same dimensions are placed together. (They model zero.)

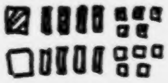
Have students suggest another model for zero using their tiles. (Many answers are possible.)

Have students name the property of the real numbers for which a number added to its opposite results in a zero sum. (additive inverse)

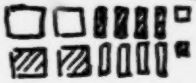
Using the Algebra Tiles for the Overhead Projector, model the polynomial $2x^2 + x + 3$, and have students create its additive inverse using their own tiles.



Using the Algebra Tiles for the Overhead Projector, model the polynomial $-x^2 - 4x - 5$, and have students draw the tiles which represent its additive inverse.



Display the polynomial 2x2 - 4x + 1. Have students suggest a tiles model for its additive inverse.

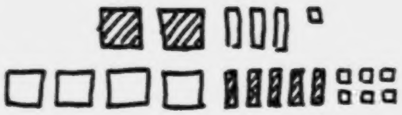


Using the Algebra Tiles for the Overhead Projector, model the polynomial $-4x2 + x - 3$. Have students write in algebraic symbols the representation for its additive inverse. $(4x^2 - x + 3)$

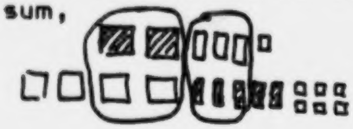
Display the sum:

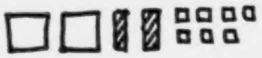
$$\begin{array}{r} -2x^2 + 3x + 1 \\ + \; 4x^2 - 5x + 6 \\ \hline \end{array}$$

Model the two polynomials on the overhead projector while students create their models at their desks.



Have students group all like tiles together then find all models for zero in each group. Have them model the resulting sum,





and then write the symbolic representation for the sum.

Ans.

$$\begin{array}{r} -2x^2 + 3x + 1 \\ + \; 4x^2 - 5x + 6 \\ \hline 2x^2 - 2x + 7 \end{array}$$

COMPUTER ACTIVITY (Approximately 10-15 minutes)

[If a computer lab is not available, the teacher can bring a single computer with a large screen display to the classroom and conduct the following lesson as a whole-group activity.]

Ask students to move in pairs to a computer where the program Polynomial Practice Using Tiles has been loaded with the "Addition of Polynomials" option already selected. Students should be directed to choose #3 (exercises with a random mixture of positive and negative coefficients) and to do ten exercises. Students should record the symbolic representation for each exercise selected (and which appears on the computer screen in pictorial form) on the Student Record Sheet. They also should record the number of exercises which were done correctly on the first try and the number done correctly on the second try. This information will appear on the screen when the lesson has been completed or exited.

The teacher can assign more program exercises as necessary while circulating around the room to insure that each student has an opportunity to work with the program.

ADDITION OF POLYNOMIALS USING TILES - Day 2
LABORATORY EXERCISES
STUDENT RECORD SHEET

COMPUTER ACTIVITY

1. Use the TILES program with the Addition of Polynomials option selected as directed by your teacher. Choose #3 from its menu, Addition of Polynomials with Positive and Negative Coefficients, and do ten exercises.

1) 2)

3) 4)

5) 6)

7) 8)

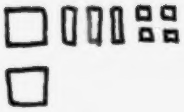
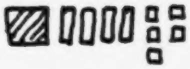
9) 10)

2. Record of Results given by the computer

Number correct a) on Try 1: ____ b) on Try 2: ____

ADDITION OF POLYNOMIALS - Day 2
WITH POSITIVE AND NEGATIVE COEFFICIENTS
HOMEWORK EXERCISES

1. For each model of a polynomial:
   - a) Draw the model for its additive inverse.
   - b) Use algebraic symbols. Give the polynomial and its additive inverse.

MODEL	MODEL OF INVERSE	NAMES OF POLYMONIAL (P) AND ADDITIVE INVERSE (AI)
		(P)____________________ (AI)____________________
		(P)____________________ (AI)____________________

---

2. Draw tiles to represent the polynomial and its additive inverse.

POLYNOMIAL	MODEL OF POLYNOMIAL	MODEL OF ADDITIVE INVERSE
a. $3x^2 - 7x - 6$		
b. $-2x^2 + 4$		
c $x^2 - 6x + 9$		
d. $-4x2 + 2x - 3$		

3. Draw tiles to represent each polynomial and the sum. Encircle the pairs of tiles that model zero.

a.
$$\begin{array}{r} -x^2 + 5x + 2 \\ +\ \ 4x^2 + x - 7 \\ \hline 3x^2 + 6x - 5 \end{array}$$

b)
$$\begin{array}{r} 6x^2 - 8x + 2 \\ +\ -4x^2 + 6x - 1 \\ \hline 2x^2 - 2x + 1 \end{array}$$

4. Add the polynomials. Use tiles if necessary.

a.
$$\begin{array}{r} -3x^2 - 2x - 1 \\ +\ \ 4x^2 + 5x - 2 \\ \hline \end{array}$$

b.
$$\begin{array}{r} 5x^2 + x + 7 \\ +\ -3x^2 - 2x - 5 \\ \hline \end{array}$$

c.
$$\begin{array}{r} -7x^2 \qquad - 3 \\ +\ \ 4x^2 \qquad + 7 \\ \hline \end{array}$$

d.
$$\begin{array}{r} x^2 \qquad - 9 \\ +\ -2x^2 \qquad + 3 \\ \hline \end{array}$$

e.
$$\begin{array}{r} 6x^2 + 4x - 3 \\ +\ \ 2x^2 - 3x - 1 \\ \hline \end{array}$$

f.
$$\begin{array}{r} -x^2 + 2x + 6 \\ +\ -4x^2 + 5x - 9 \\ \hline \end{array}$$

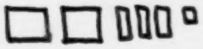
g.
$$\begin{array}{r} 3x^2 - 7x + 2 \\ +\ \ -x^2 + 5x + 3 \\ \hline \end{array}$$

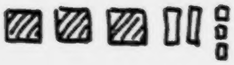
h.
$$\begin{array}{r} 3x^2 - 7x + 2 \\ +\ \ x^2 - 5x - 3 \\ \hline \end{array}$$

i.
$$\begin{array}{r} -2x^2 + 9x - 6 \\ +\ \ 4x^2 - 2x - 2 \\ \hline \end{array}$$

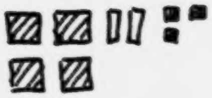
j.
$$\begin{array}{r} -2x^2 + 9x - 6 \\ +\ -4x^2 + 2x + 2 \\ \hline \end{array}$$

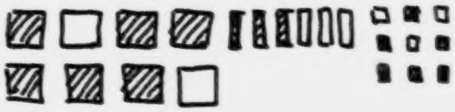
5. What two polynomials could be added to give the illustrated model? Check your answer by constructing models with your algebra tiles.

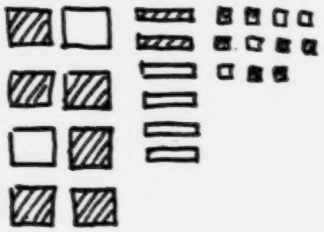
a. 

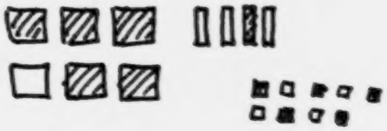
b. 

6. Name the polynomial given by the pictorial representation (Use the Zero Principle to help simplify your answer.)

a. 

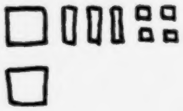
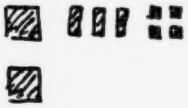
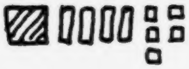
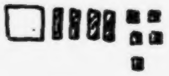
b. 

c. 

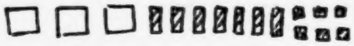
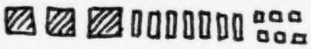
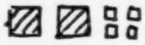
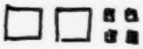
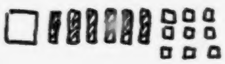
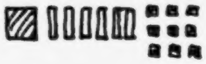
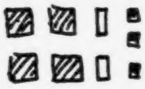
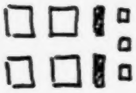
d. 

ADDITION OF POLYNOMIALS - Day 2
WITH POSITIVE AND NEGATIVE COEFFICIENTS
HOMEWORK EXERCISES
ANSWERS

1. For each model of a polynomial:
    a) Draw the model for its additive inverse.
    b) Use algebraic symbols. Give the polynomial and its additive inverse.

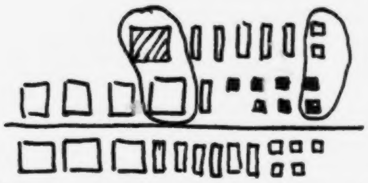
MODEL	MODEL OF INVERSE	NAMES OF POLYMONIAL (P) AND ADDITIVE INVERSE (AI)
		(P) $2x^2 + 3x + 4$ (AI) $-2x^2 - 3x - 4$
		(P) $-x^2 + 4x + 5$ (AI) $x^2 - 4x - 5$

2. Draw tiles to represent the polynomial and its additive inverse.

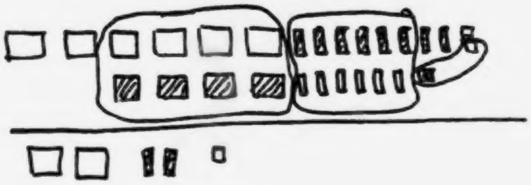
POLYNOMIAL	MODEL OF POLYNOMIAL	MODEL OF ADDITIVE INVERSE
a. $3x^2 - 7x - 6$		
b. $-2x^2 + 4$		
c $x^2 - 6x + 9$		
d. $-4x2 + 2x - 3$		

3. Draw tiles to represent each polynomial and the sum. Encircle the pairs of tiles that model zero.

a.
$$\begin{array}{r} -x^2 + 5x + 2 \\ +\ \ 4x^2 + x - 7 \\ \hline 3x^2 + 6x - 5 \end{array}$$



b)
$$\begin{array}{r} 6x^2 - 8x + 2 \\ +\ -4x^2 + 6x - 1 \\ \hline 2x^2 - 2x + 1 \end{array}$$



4. Add the polynomials. Use tiles if necessary.

a.
$$\begin{array}{r} -3x^2 - 2x - 1 \\ +\ \ 4x^2 + 5x - 2 \\ \hline x^2 + 3x - 3 \end{array}$$

b.
$$\begin{array}{r} 5x^2 + x + 7 \\ +\ -3x^2 - 2x - 5 \\ \hline 2x^2 - x + 2 \end{array}$$

c.
$$\begin{array}{r} -7x^2 \qquad - 3 \\ +\ \ 4x^2 \qquad + 7 \\ \hline -3x^2 + 4 \end{array}$$

d.
$$\begin{array}{r} x^2 \qquad - 9 \\ +\ -2x^2 \qquad + 3 \\ \hline -x^2 \quad - 6 \end{array}$$

e.
$$\begin{array}{r} 6x^2 + 4x - 3 \\ +\ \ 2x^2 - 3x - 1 \\ \hline 8x^2 + x - 4 \end{array}$$

f.
$$\begin{array}{r} -x^2 + 2x + 6 \\ +\ -4x^2 + 5x - 9 \\ \hline -5x^2 + 7x - 3 \end{array}$$

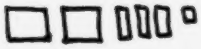
g.
$$\begin{array}{r} 3x^2 - 7x + 2 \\ +\ \ -x^2 + 5x + 3 \\ \hline 2x^2 - 2x + 5 \end{array}$$

h.
$$\begin{array}{r} 3x^2 - 7x + 2 \\ +\ \ \ x^2 - 5x - 3 \\ \hline 4x^2 - 12x - 1 \end{array}$$

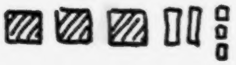
i.
$$\begin{array}{r} -2x^2 + 9x - 6 \\ +\ \ 4x^2 - 2x - 2 \\ \hline 2x^2 + 7x - 8 \end{array}$$

j.
$$\begin{array}{r} -2x^2 + 9x - 6 \\ +\ -4x^2 + 2x + 2 \\ \hline -6x^2 + 11x - 4 \end{array}$$

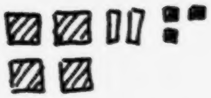
5. What two polynomials could be added to give the illustrated model? Check your answer by constructing models with your algebra tiles.

a. 

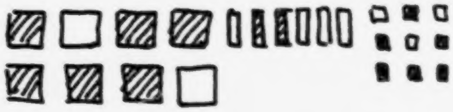
Answers will Vary.

b. 

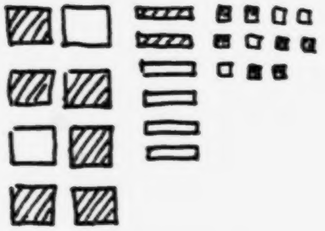
6. Name the polynomial given by the pictorial representation (Use the Zero Principle to help simplify your answer.)

a. 

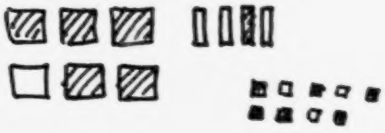
$-4x^2+2x-3$

b. 

$-4x^2+2x-3$

c. 

$-4x^2+2x-3$

d. 

$-4x^2+2x-3$

COMPUTER SOFTWARE PROGRAM REVIEW AND DESCRIPTION

TITLE: **INTERPRETING GRAPHS**

PUBLISHER: Sunburst Communications
29 Washington Avenue
Pleasantville NY 10570

PRICE: $65.00
10-disk lab pack $195.00

COMPUTERS: Apple II+; IIc; IIe

PIMMS RATING: Very Good

PROGRAM IS APPROPRIATE FOR:

Course: General Math, Applied Math, all algebra courses

Ability Level: average to high

Format: classroom demonstration/laboratory

Characteristics: disk-dependent between menus, disk independent within a menu, user-friendly, graphics, support materials, documentation

ADDITIONAL PERIPHERALS NEEDED: color monitor preferred

REVIEW AND DESCRIPTION OF THE PROGRAM:

INTERPRETING GRAPHS is a software package that provides practice in selecting an appropriate graph to represent a given physical situation.

The user is presented with three graphs superimposed on one set of coordinate axes and a description of a physical situation (e.g., a car travelling at a constant rate). The axes are labelled (e.g., distance and rate). The user is asked to select the graph that correctly depicts the physical situation.

Twenty (20) situations are presented; the order of the exercises changes each time the user runs the program. The user may stop at any time via the ESCAPE key (ESC). When the user completes all twenty exercises, a tally of the number of correct responses is given and the user is given the option of redoing the missed items.

New users may select the Introduction from the menu to see two examples of the process.

A game called ESCAPE is part of the package. This game gives practice in plotting points in the coordinate plane: Bank robbers are placed at the origin and try to escape capture. The student tries to thwart their escape by setting up blockades (via coordinates) in the path of the robbers.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: RELATING GRAPHS TO EVENTS

OBJECTIVE:

To recognize a graph that generally describes a given physical situation

COURSES: General Math, Applied Math, Algebra I, II

SOFTWARE PACKAGE: INTERPRETING GRAPHS (Sunburst)

PREQUISITE SKILLS/CONCEPTS:

- simple linear graphing concepts
- physical relationships such as that for speed, time, and distance.

FORMAT: classroom demonstration/lab:

GENERAL DESCRIPTION OF THE LAB ACTIVITY:

The Introduction section of the Relating Graphs to Events part of the package may be used to demonstrate the use of the program and to set forth the underlying concept of the lesson. This section provides graphical descriptions of physical situations involving increase, decrease, and constancy. The lesson contains four classroom exercises based on the introduction.

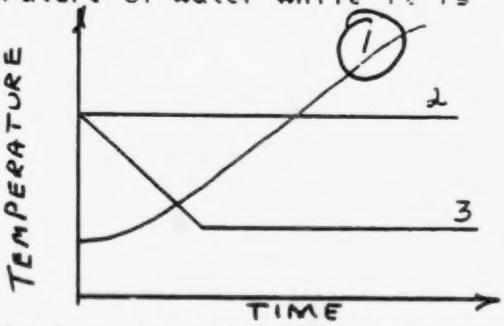
At the outset it might be advisable to explain to students that physical behavior cannot happen abruptly (as indicated by a graph containing a sharp change of direction), but happens over time - as indicated by a gradual (curving) change of direction.

RELATING GRAPHS TO EVENTS
LABORATORY EXERCISES
ANSWERS

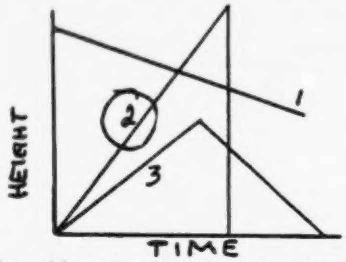
CLASSROOM DEMONSTRATION EXERCISES

Following the classroom demonstration of the program, do these exercises before you proceed to the computer activity.

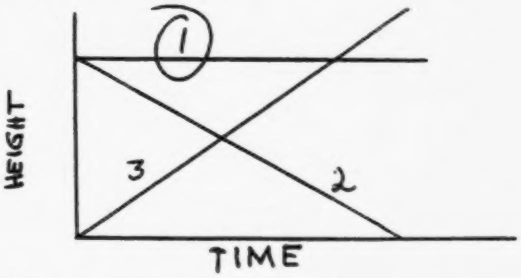
1. Which graph shows the temperature of water while it is being heated to make tea?



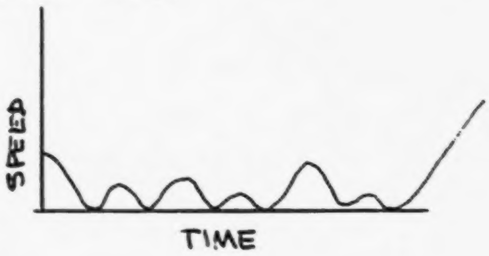
2. Which graph shows the height of a cornstalk from the day it begins to grow until the day after it is chopped down?



3. Which graph shows the change in the height of the school flagpole during a 24-hour period?



4. Draw a graph to show the speed of a car going through a highway toll booth behind five other cars.

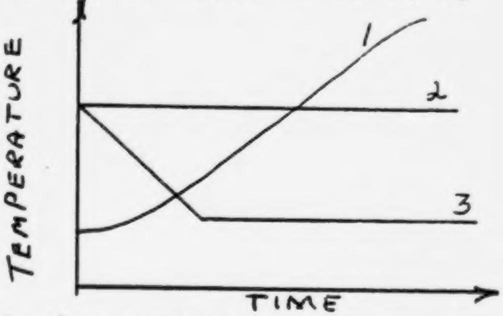


RELATING GRAPHS TO EVENTS
LABORATORY EXERCISES

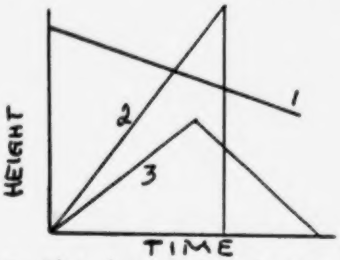
CLASSROOM DEMONSTRATION EXERCISES

Following the classroom demonstration of the program, do these exercises before you proceed to the computer activity.

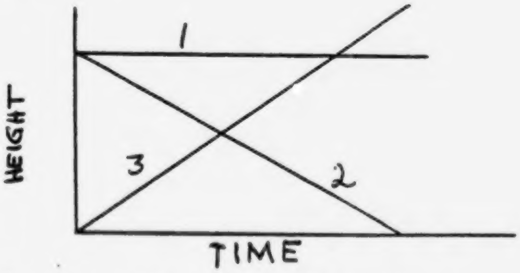
1. Which graph shows the temperature of water while it is being heated to make tea?



2. Which graph shows the height of a cornstalk from the day it begins to grow until the day after it is chopped down?



3. Which graph shows the change in the height of the school flagpole during a 24-hour period?



4. Draw a graph to show the speed of a car going through a highway toll booth behind five other cars.

RELATING GRAPHS TO EVENTS
LABORATORY EXERCISES

COMPUTER ACTIVITY (20 minutes):

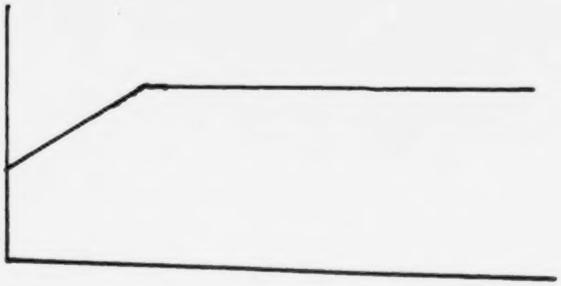
As directed by your teacher, choose the Relating Graphs to Events section from the menu of the Interpreting Graphs software package. Do the 20 practice exercises. Upon completion of the exercises, note the number of correct responses (given by the program) and re-try missed items.

Number of exercises done correctly: ______

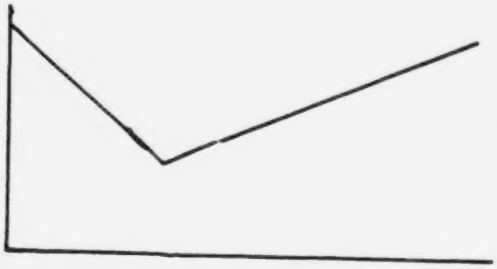
RELATING GRAPHS TO EVENTS
HOMEWORK EXERCISES

Write a scenario for a physical situation that might relate to the graph shown. Label the axes accordingly.

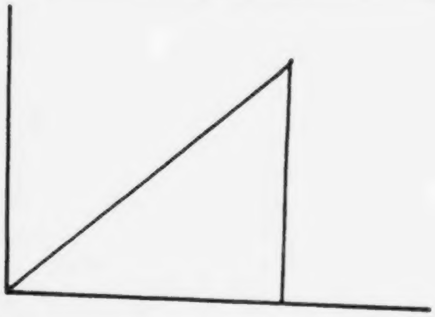
1.



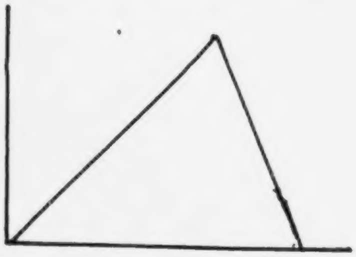
2.



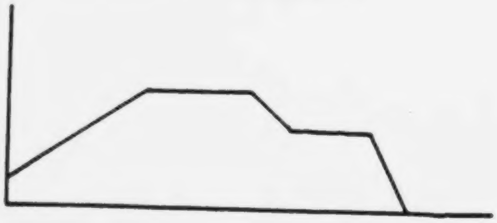
3.



4.



5.



For exs. 6 - 11, sketch a graph that is a description of the given physical situation. Label axes. (Note: "vs." is an abbreviation for "versus", and means "matched against".)

6. A plane takes off, reaches a maximum altitude, flies at that altitude for a period of time, descend, and lands. Graph the height of the plane vs. time for the trip.

7. Shoe sizes for males are available in half-sizes from size 5 to size 14 for foot lengths from 9 inches to 18 inches. Graph foot sizes vs. shoe sizes.

8. A driver traveling along a highway slows down for mowing, construction, and a radar trap at different points along the way. Graph the speed of the car for the time period containing these events.

9. A sheet of hardened snow is dislodged by the wind, blown upward from the roof of a moving auto, flies through the air, and lands on the pavement. Make a graph to show the height of the snow above the pavement for this scenario.

10. The number of gallons remaining in the gas tank of an automobile changes with the number of miles driven. Graph the relationship for:

    a) a long trip made at the highway speed limit
    b) around-town driving at different speeds
    c) a few high-speed runs around a racetrack

RELATING GRAPHS TO EVENTS
ANSWERS TO HOMEWORK EXERCISES

Answers will vary. Some generally descriptive scenarios are:

1. A hang glider starts from a cliff, rises, and levels off.

   Soup at room temperature is heated to boiling, then is allowed to simmer at a constant temperature.

2. A dessert is put into the freezer for a while, then taken out to soften up before serving.

   A plane loses altitude, then starts to climb.

3. A skier, traveling at constant speed, hits a tree.

   A rubber dart is fired at a wall, hits it, and adheres.

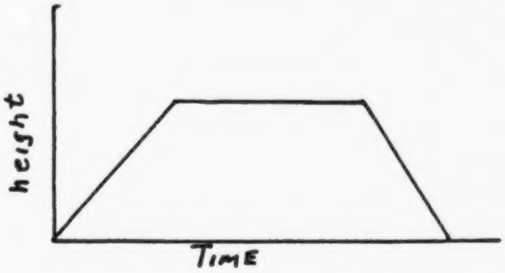
4. A ball is thrown upward, hits the ceiling, and rebounds downward.

   A skier gains speed then slows down and stops.

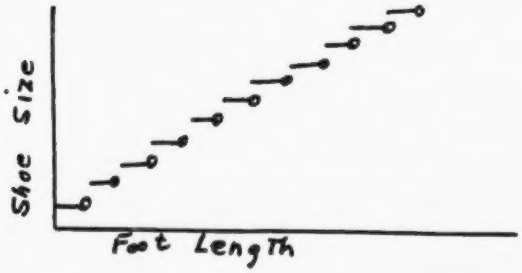
5. A driver speeds up, then drives at a constant speed, slows down for a radar trap, again drives at a constant speed, then stops at a traffic light.

   The air temperature over a 24-hour period rises from a low of 0 degrees Celsius to a daytime high, decreases as an afternoon storm approaches, remains constant for a few hours in the evening, then falls below zero overnight.

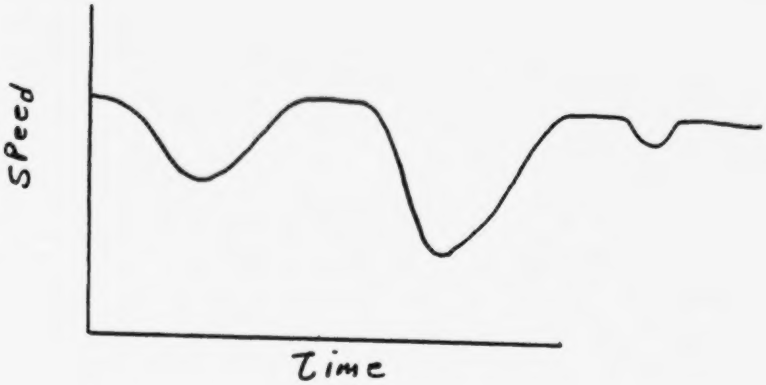
6.



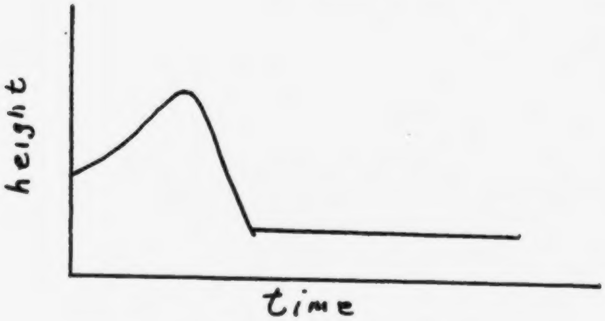
7.



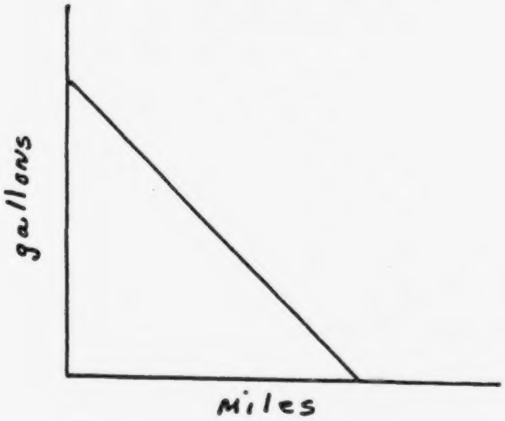
8.



9.



10.



COMPUTER SOFTWARE PROGRAM REVIEW AND DESCRIPTION

TITLE: THE GEOMETRIC preSUPPOSER
PUBLISHER: Sunburst Communications Inc.
ADRESS: 39 Washington Ave.
Pleasantville N. Y. 10570
PRICE: $99.95
10-disk lab pack $297.00
COMPUTER: APPLE IIe, IIc
PIMMS' RATING: Excellent

PROGRAM IS APPROPRIATE FOR

Course: Introductory Geometry, Geometry

Ability Level: low, middle, high

Format: class demo/instruction, discovery lab

Characteristics: user-friendly, on-screen help, edit functions,graphics, not disk-dependent, documentation

ADDITIONAL PERIPHERALS NEEDED: none

REVIEW AND DESCRIPTION OF THE PROGRAM:

THE GEOMETRIC preSUPPOSER is a flexible microcomputer program which can be used to teach geometry at the middle and high school levels. The preSupposer allows students to perform constructions which are possible with a compass and straightedge. Points, segments, angles, triangles, quadrilaterals, polygons, and circles can be constructed. The user can easily draw segments, inscribed and circumscribed circles, angle bisectors, perpendiculars, and parallels. Measurements can be made on lengths, angles, areas, and circumferences and may be combined with arithmetic combinations of sums, products, ratios, and squares. In addition, a grid with Cartesian coordinates can be displayed on any construction with ease and accuracy.

Students can become familiar with the preSUPPOSER by experimenting with its options: Draw, Label, Erase, Measure, Scale, Grid, and New Shape. The documentation accompanying the preSUPPOSER illustrates the use of each menu via simple examples, permitting its use as a tutorial.

The preSUPPOSER effectively motivates students to think about geometry by allowing them to discover theorems independently. The teacher's role is to provide a meaningful lab activity or classroom demonstration by way of the preSUPPOSER to enable the making and testing of conjectures.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: ANGLES FORMED WITH PARALLEL LINES AND TRANSVERSALS

OBJECTIVES:

to show that when two lines intersect
- vertical angles are congruent
- adjacent angles are supplementary

to show that when a tranversal intersects parallel lines
- alternate interior angles are congruent
- alternate exterior angles are congruent
- corresponding angles are congruent
- interior angles on the same side of the transversal are supplementary

COURSE: Geometry

SOFTWARE NEEDED: THE GEOMETRIC preSUPPOSER

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

Students should:

- recognize alternate interior angles, alternate exterior angles, corresponding angles, vertical angles, supplementary angles, and adjacent angles

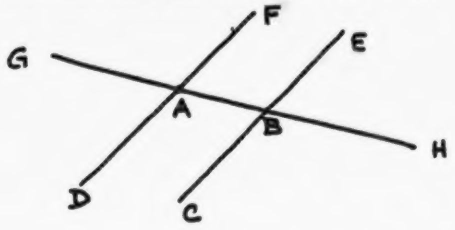
- know how to use the preSUPPOSER to draw parallel lines and transversals.

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LAB ACTIVITY

ANGLES FORMED WITH PARALLEL LINES AND TRANSVERSALS
LABORATORY EXERCISES

The following diagram shows the figure that these directions will enable you to construct on the screen.



DIRECTIONS FOR DRAWING TWO PARALLEL LINES INTERSECTED BY A TRANSVERSAL. Note: ESCape may be used to go back to a previous response.

MENU CHOICE	RESPONSE
New Shape	N
Quadrilateral	5
Parallelogram	2
Random	1
Erase	3
Erase Segment	2
Segment Name	CD
	Return
	Escape
Draw	1
Extension	3
Extend Segment	BC
	Return
By Movable Point	2
	Arrow Key along BC
	Return
	Return
Extension	3
Segment Name	AD
By Movable Point	2
	Arrow Key along AD
	Return
	Return
Extension	3
Segment	AB
By Movable Point	2
	Arrow Key along AB
	Return
	Arrow Key along AB
	Return

ANGLES FORMED WITH PARALLEL LINES AND TRANSVERSALS
LABORATORY EXERCISES

DIRECTIONS:
Use the preSUPPOSER to construct two parallel lines cut by a transversal. In the diagram space below, reproduce the construction shown on the screen. Use the numbers 1 through 8 to label all angles formed by the intersecting lines. Use the MEASURE option to measure the angles formed and include that information in the diagram.

DIAGRAM

1) a) How many pairs of alternate interior angles exist?

   b) Name each pair.

   c) Based on the measure of each pair, state a conjecture about alternate interior angles.

2) a) How many pairs of alternate exterior angles exist?

   b) Name each pair.

   c) State a conjecture about alternate exterior angles.

3) a) How many pairs of corresponding angles exist?

   b) Name each pair.

   c) State a conjecture about corresponding angles.

4) a) How many pairs of vertical angles exist?

   b) Name each pair.

   c) State a conjecture about vertical angles.

5) a) How many pairs of adjacent angles exist?

   b) Name each pair.

   c) State a conjecture about how the angles in each pair are related.

ANGLES FORMED WITH PARALLEL LINES AND TRANSVERSALS
HOMEWORK EXERCISES

1. In Figure 1, line n is parallel to line m and they intersect transversals t and v. When the measure of angle 1 is given to be 105 degrees in the figure below, show the measures of the other angles.

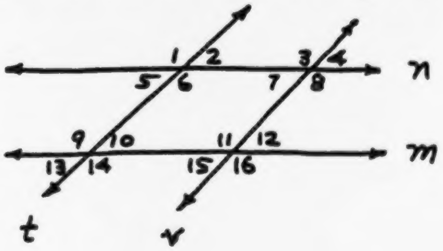


Figure 1

a) Which angle(s) correspond(s) to angle 1?

b) Which angle(s) are alternate interior angle(s) with angle 11?

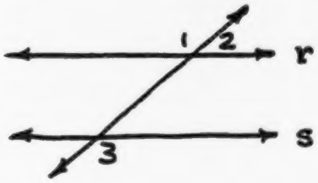
c) Which angle(s) are alternate exterior pair(s) with angle 13?

d) How many vertical pairs are there? Name them.

e) Which angle(s) is/are adjacent to angle 7?

f) Which angle(s) is/are supplementary to angle 7?

Figure 2



2) Use Figure 2. Line r is parallel to line s , $m\angle 1 = 3X - 3$, and $m\angle 3 = 4X - 41$. Find X.

3) Use Figure 2. Line r is parallel to line s, $m\angle 1 = Y$, $m\angle 2 = X$, and $m\angle 3 = X - 4$. Find X and Y.

ANGLES FORMED WITH PARALLEL LINES AND TRANSVERSALS
ANSWERS TO HOMEWORK EXERCISES

1. In Figure 1, line n is parallel to line m and they are cut by transversals t and v. If the measure of angle 1 is 105 degrees, label all of the missing angles in the figure provided below.

angles 1, 3, 6, 8, 9, 11, 14, 16 measure 105 degrees
angles 2, 4, 5, 7, 10, 12, 13, 15 measure 75 degrees

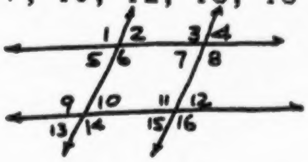


Figure 1

a) Which angle(s) correspond(s) to angle 1? 3 & 9

b) Which angle(s) is/are alternate interior angle(s) with angle 11? 8 & 14

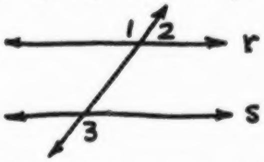
c) Which angle(s) is/are alternate exterior pair(s) with angle 13? 2 & 12

d) How many vertical pairs are there? 8 Name them.
1 & 6, 2 & 5, 3 & 8, 4 & 7, 9 & 14, 10 & 13, 11 & 16, 12 & 15

e) Which angle(s) is/are adjacent to angle 7? 3 & 8

f) Which angle(s) is/are supplementary to angle 7?
1, 3, 6, 8, 9, 11, 14, 16

Figure 2



2) Use Figure 2. Line r is parallel to line s, m∠1 = 3X - 3 m∠3 = 4X - 41. Find X:

$$3X - 3 = 4X - 41$$
$$X = 38$$

3) Use Figure 2. Line r is parallel to line s, m∠1= Y, m∠2 =X, and m∠3 = X - 4. Find X and Y:

$$X + Y = 180$$
$$Y = X - 4$$
$$X = 92$$
also, $Y = 8$

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: RIGHT TRIANGLES

OBJECTIVES:

To show that for right triangles:

When an altitude is drawn to the hypotenuse, the two triangles formed are similar to the given triangle and to each other.

The length of a leg is the geometric mean between the length of the hypotenuse and the length of the projection of that leg on the hypotenuse.

The length of the altitude drawn to the hypotenuse is the geometric mean of the lengths of the segments of the hypoteneuse.

The product of the lengths of the hypotenuse and the altitude drawn to the hypotenuse equals the product of the lengths of the legs.

COURSE: Geometry

SOFTWARE NEEDED: THE GEOMETRIC preSUPPOSER or GEOMETRIC SUPPOSER

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

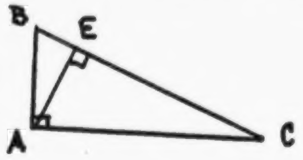
The student should know the parts of a right triangle and the definition of geometric mean.

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LAB ACTIVITY

RIGHT TRIANGLES
LABORATORY EXERCISES

The following diagram shows the figure that these directions will enable you to construct using the preSUPPOSER.



DIRECTIONS FOR DRAWING AN ALTITUDE TO THE HYPOTENUSE OF A RIGHT TRIANGLE. (Note: ESCape may be used to go back to a previous response.)

MENU CHOICE	RESPONSE
New Shape	N
Triangle	4
Right	1
Draw	1
Perpendicular	6
Point	A
	Return
To Line	BC
	Return
By Movable Point	2
	Use arrow key along the perpendicular until point is defined in exterior of triangle
	Return
	Return
	Escape
Label	2
Intersection	1
Line	AD
	Return
With Line	BC
	Return
	Escape
Erase	3
Segment	2
	ED
	Return
Point	1
	D
	Return
	Escape

RIGHT TRIANGLES
LABORATORY EXERCISES

1. DIRECTIONS:
   Use the preSUPPOSER to draw a right triangle and the altitude to the hypotenuse of the right triangle formed. In the space below, reproduce the figure, then complete the data table.The same figure should be used to complete the data tables on the two following pages. Having done this, repeat the steps for a second triangle.

   DIAGRAMS:

a)	Right Triangle 1	Right Triangle 2
m∠BAC		
m∠ABC		
m∠ACB		
m∠AEB		
m∠ABE		
m∠BAE		
m∠AEC		
m∠EAC		
m∠ACE		

Complete the data tables on the next two pages for Triangle 1 before repeating the measurements on Triangle 2.

Based upon the information in the completed table above, state a conjecture about the relationship of the two triangles.

b)	Right Triangle 1	Right Triangle 2
BE		
AB		
BC		
$\frac{BE}{AB}$		
$\frac{AB}{BC}$		
EC		
AC		
BC		
$\frac{EC}{AC}$		
$\frac{AC}{BC}$		

To help form a second conjecture, it may be useful to compare the length of a leg of a right triangle with its projection on the hypotenuse. After comparing both legs in this manner using the completed data table above, state a conjecture.

$\frac{BC}{AB} = \frac{AB}{EB}$ and $\frac{CE}{AC} = \frac{AC}{BC}$

c) Draw a diagram and complete the following data tables.

	Right Triangle 1	Right Triangle 2
BE		
AE		
CE		
$\frac{BE}{AE}$		
$\frac{AE}{EC}$		

State a conjecture based upon the completed data table above.

	Right Triangle 1	Right Triangle 2
AE		
BC		
AE*BC		
AB		
AC		
AB*AC		

State a conjecture based upon the completed data table above.

RIGHT TRIANGLES
HOMEWORK EXERCISES

Use Figure A for exercises 1-4.

1. $\frac{w}{?} = \frac{?}{w+x}$

2. $\frac{x}{?} = \frac{?}{w+x}$

3. $\frac{w}{?} = \frac{?}{x}$

4. $yz = v?$

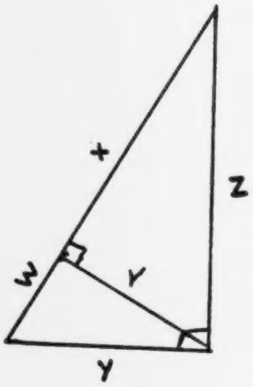


Figure A

Use Figure B for Exercises 6-10.
Triangle ABC is Given with $\overline{AC} \perp \overline{BC}$ and $\overline{CD} \perp \overline{AB}$.

5. For AD = 4, DB = 9, find CD.

6. For AD = 2, DB = 4, find AC, CD, and BC.

7. For AC = 4, BC = 3, and AB = 5, find CD.

8. For AB = 8, DB = 6, find AC.

9. For DC = 5, DB = 6, find AD.

10. For AB = 12, DB = 8, find BC.

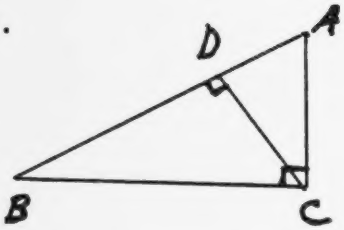


Figure B

RIGHT TRIANGLES
ANSWERS TO HOMEWORK EXERCISES

1. y

2. z

3. v

4. w + x

5. $\frac{4}{CD} = \frac{CD}{9}$

   $CD = 6$

6. $\frac{6}{AC} = \frac{AC}{2}$ $\quad \frac{2}{CD} = \frac{CD}{4}$ $\quad \frac{6}{BC} = \frac{BC}{4}$

   $AC = 2\sqrt{3}$ $\quad CD = 2\sqrt{2}$ $\quad BC = 2\sqrt{6}$

7. $5CD = 3(4)$

   $CD = 12/5$

8. $\frac{2}{AC} = \frac{AC}{8}$

   $AC = 4$

9. $\frac{AD}{5} = \frac{5}{6}$

   $AD = 25/6$

10. $\frac{8}{BC} = \frac{BC}{12}$

   $BC = 4\sqrt{6}$

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: SEGMENTS AND AREAS OF QUADRILATERALS

OBJECTIVES:

to show that the segments joining the midpoints of a quadrilateral form a parallelogram

to show that the ratio of the area of a given quadrilateral to the area of the quadrilateral formed by joining midpoints is 2:1

COURSE: Geometry

SOFTWARE NEEDED: THE GEOMETRIC preSUPPOSER

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

The student should be able to draw various quadrilaterals, label midpoints, measure segments, and find areas of quadrilaterals using the preSUPPOSER.

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LAB ACTIVITY

SEGMENTS AND AREAS OF QUADRILATERALS
LABORATORY EXERCISES

DIRECTIONS:
Use the preSUPPOSER to construct quadrilateral ABCD having midpoints E, F, G, H on AB, BC, CD, and AD respectively. Join these midpoints by line segments and state a conjecture about how these segments are related and what type of figure they form. Also make a conjecture about the areas of quadrilaterals ABCD and EFGH. Repeat these steps for the following quadrilaterals and record your data in the tables to support your conjectures: 1) Random 2) Kite 3) Trapezoid and 4) Parallelogram.

1. Draw and Label each figure on the screen and copy them here.

a)

b)

	a) RANDOM QUADRILATERAL	b) KITE
EF		
FG		
GH		
EH		
m ∠EFG		
m ∠FGH		
m ∠EHG		
m ∠HEF		
AREA ABCD		
AREA EFGH		

2. Draw and Label each quadrilateral on the screen and copy them here.

a) b) c)

TRAPEZOIDS

	a) Random	b) Isosceles	c) Right
EF			
FG			
GH			
EH			
m∠EFG			
m∠FGH			
m∠EHG			
m∠HEF			
AREA ABCD			
AREA EFGH			

3. Draw and Label each quadrilateral on the screen and copy them here.

a)

b)

c)

d)

PARALLELOGRAMS

	a) Random	b) Rectangle	c) Rhombus	d) Square
EF				
FG				
GH				
EH				
m ∠EFG				
m ∠FGH				
m ∠EHG				
m ∠HEF				
AREA ABCD				
AREA EFGH				

4. Using data from the lab activity, identify the type of figure that results when the midpoints of the sides of the given quadrilateral are joined.

Quadrilateral ABCD	Quadrilateral EFGH
1. Random Quadrilateral	
2. Isosceles Trapezoid	
3. Random Trapezoid	
4. Right Trapezoid	
5. Random Parallelogram	
6. Rectangle	
7. Rhombus	
8. Square	
9. Kite	

10. Make a conjecture about the area of a given quadrilateral and that of the quadrilateral formed by joining the midpoints of its sides.

SEGMENTS AND AREAS OF QUADRILATERALS
ANSWERS TO LABORATORY EXERCISES

1.- 3. (Drawings and data will vary.)

4. Using data from the lab activity, tell what type of figure results when the midpoints of the sides of each quadrilateral are joined.

Quadrilateral ABCD	Quadrilateral EFGH
1. Random Quadrilateral	Parallelogram
2. Isosceles Trapezoid	Rhombus
3. Random Trapezoid	Parallelogram
4. Right Trapezoid	Parallelogram
5. Random Parallelogram	Parallelogram
6. Rectangle	Rhombus
7. Rhombus	Rectangle
8. Square	Square
9. Kite	Rectangle

10. What conjecture can be made about the areas of the given quadrilateral and the quadrilateral formed by joining the midpoints of the sides?

Ratio is 2:1

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: SPECIAL SEGMENTS IN A TRIANGLE

OBJECTIVES:

To show that

When a ray bisects an angle of a triangle, it divides the opposite side into segments whose lengths are proportional to the lengths of the other two sides.

When two triangles are similar, the lengths of corresponding altitudes have the same ratio as the lengths of corresponding sides.

COURSE: Geometry

SOFTWARE NEEDED: THE GEOMETRIC preSUPPOSER or
GEOMETRIC SUPPOSER:TRIANGLES

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

Familiarity with the terminology **angle bisector** and **altitude**.

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LAB ACTIVITY

SPECIAL SEGMENTS IN A TRIANGLE
LABORATORY EXERCISES: ANGLE BISECTORS

DIRECTIONS:

Use the preSUPPOSER to draw three types of triangles from the given choice of five. Construct triangle ABC and use the directions to bisect angle BAC with segment AE. Then reproduce the diagram here and complete the data tables.

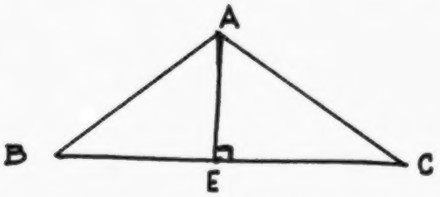
DIAGRAM

	Triangle 1	Triangle 2	Triangle 3
BE			
EC			
$\frac{BE}{EC}$			
AB			
AC			
$\frac{AB}{AC}$			

State a conjecture about a ray that bisects an angle of a triangle and divides the opposite side into two segments.

SPECIAL SEGMENTS IN A TRIANGLE
DIRECTIONS FOR DRAWING ALTITUDES

The following diagram shows the figure that the directions will enable you to construct using the preSUPPOSER.



DIRECTIONS FOR DRAWING THE ALTITUDE FROM A TRIANGLE VERTEX

Note: ESCape may be used to go back to a previous response.

MENU CHOICE	RESPONSE
New Shape	N
Triangle	4
	Select type of triangle
Draw	1
Perpendicular	6
Through Point	A
	Return
To Line	BC
	Return
By Movable Point	2
	Use arrow key along bisector until point is in exterior of triangle
	Return
	Return
	Escape
Label	2
Intersection	1
Of Line	BC
	Return
With Line	AD
	Return
	Escape
Erase	3
Segment	2
	ED
	Return
Label	3
	D
	Return
	Escape

SPECIAL SEGMENTS IN A TRIANGLE
LABORATORY EXERCISES: ALTITUDES

DIRECTIONS:

Use the preSUPPOSER to draw two types of triangles from the menu choice of five. Construct triangle ABC and use the directions to draw altitude AE from angle BAC. Next, use the SCALE option to produce a similar triangle which we will name triangle A′B′C′. Complete the data table for Triangle 1 then repeat this process for the second type of triangle (Triangle 2). A calculator may be used to find decimal approximations for the ratios.

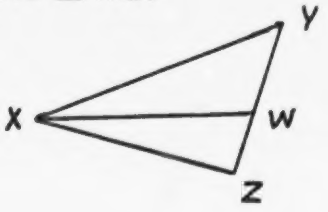
	Triangle 1	Triangle 2
AB		
BC		
AC		
AE		
A′B′		
B′C′		
A′C′		
A′E′		
$\frac{AB}{A'B'}$		
$\frac{BC}{B'C'}$		
$\frac{AC}{A'C'}$		
$\frac{AE}{A'E'}$		

State a conjecture based on the recorded data.

SPECIAL SEGMENTS IN A TRIANGLE
HOMEWORK EXERCISES

In Figure A, $\overline{WX}$ bisects $\angle YXZ$.

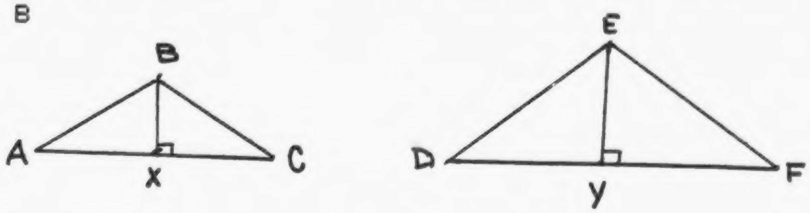
FIGURE A



1. When WY = 3, XY = 4, and XZ = 6, find WZ.
2. When YZ = 7, WZ = 3, and XY = 4, find XZ.
3. When XZ = 3, XY = 5, and YZ = 7, find WZ and WY.
4. When YZ = 12, XY = 5, and XZ = 5, find WZ and WY.
5. When WY = x, WZ = 2x, and XY = 9, find XZ.

In Figure B, $\triangle ABC \sim \triangle DEF$. $\overline{BX}$ and $\overline{EY}$ are altitudes.

FIGURE B



6. If AB = 8, DE = 12, and BX = 5, find EY.
7. When BX = 4, EY = 7, and DF = 16, find AC.
8. Use the information in Exercise 7 to help form a conjecture about the areas of similar triangles.

SPECIAL SEGMENTS IN A TRIANGLE
ANSWERS TO HOMEWORK EXERCISES

1. $$\frac{6}{WZ} = \frac{4}{3}$$

   $WZ = 9/2$

2. $$\frac{XZ}{3} = \frac{4}{4}$$

   $XZ = 3$

3. $$\frac{3}{7-X} = \frac{5}{X}$$

   $WZ = 21/8$

   $WY = 35/8$

4. $$\frac{5}{12-X} = \frac{5}{X}$$

   $WZ = 6$

   $WY = 6$

5. $$\frac{XZ}{2X} = \frac{9}{X}$$

   $XZ = 18$

6. $$\frac{8}{12} = \frac{5}{EY}$$

   $EY = 15/2$

7. $$\frac{AC}{16} = \frac{4}{7}$$

   $AC = 64/7$

8. The ratio of the areas of two similar triangles equals the square of the ratio of the altitudes (or other corresponding parts).

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: SEGMENT PARALLEL TO SIDE OF TRIANGLE

OBJECTIVE:

To show that if a line is parallel to one side of a triangle and intersects the other two sides, then it divides them proportionally.

COURSE: Geometry

SOFTWARE NEEDED: THE GEOMETRIC preSUPPOSER or GEOMETRIC SUPPOSER

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

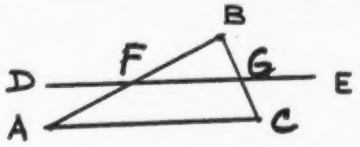
Student should be familiar with using the software.

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LAB ACTIVITY

SEGMENT PARALLEL TO SIDE OF TRIANGLE
DIRECTIONS FOR DRAWING SEGMENT

The following diagram shows the figure that the directions will enable you to construct using the preSUPPOSER.



DIRECTIONS FOR DRAWING A LINE PARALLEL TO ONE SIDE OF A TRIANGLE
Note: ESCape may be used to go back to a previous response.

MENU CHOICE	RESPONSE
New Shape	N
Triangle,	4
Type	1-5
Label	2
Movable Point	4
	Use arrow keys to locate a point in the exterior of the triangle opposite angle A.
	Return
	Escape
Draw	1
Parallel	5
Through Point	D
	Return
Parallel to Line	AC
	Return
By Movable Point	2
	Use arrow keys to locate a point in the exterior of the triangle opposite angle C.
	Return
	Return
	Escape
Label	2
Intersection	1
Of Line	BC
	Return
With Line	DE
Intersection	1
Of Line	AB
	Return
With Line	DE
	Return
	Escape

SEGMENT PARALLEL TO SIDE OF TRIANGLE
LABORATORY EXERCISES

DIRECTIONS:

Use the preSUPPOSER and the directions provided to draw a triangle with segment FG parallel to side AC. Record the data in the table. Repeat the procedure for two other types of triangles.

	Triangle 1	Triangle 2	Triangle 3
BF			
FC			
BC			
BG			
AG			
AB			
$\frac{BF}{FC}$			
$\frac{BG}{AG}$			
$\frac{BC}{BF}$			
$\frac{AB}{BG}$			
$\frac{BC}{FC}$			
$\frac{AB}{AG}$			

State a conjecture based on the information in the data table above.

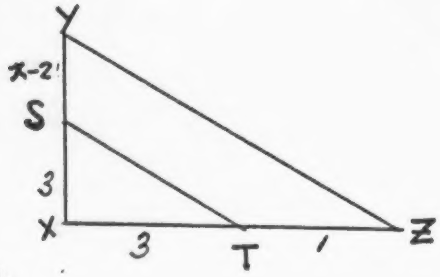
SEGMENT PARALLEL TO SIDE OF TRIANGLE
HOMEWORK EXERCISES

Given $\triangle ABC$ with $\overline{XY} \parallel \overline{BC}$.

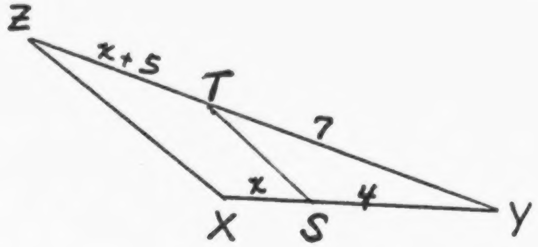
1. CX = 4, AX = 2, and AY = 3, find BY.
2. AX = 3, AC = 7, and AB = 8, find AY.
3. AB = 9, BY = 3, and AC = 6, find AX.
4. XC = AY, AX = 4, and BY = 8, find AY.
5. AY XC = AX ?
6. AC ? = AB XC

For Exercises 7-10, $\triangle XYZ$ is Given with $\overline{ST} \parallel \overline{YZ}$. Find x.

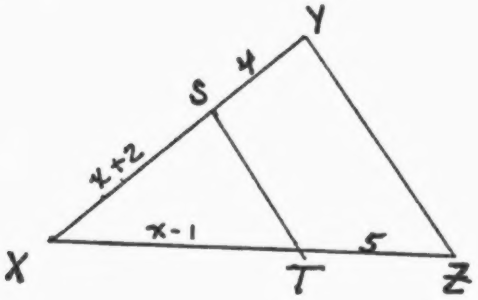
7.


Y
x-2
S
3
X
3
T
1
Z

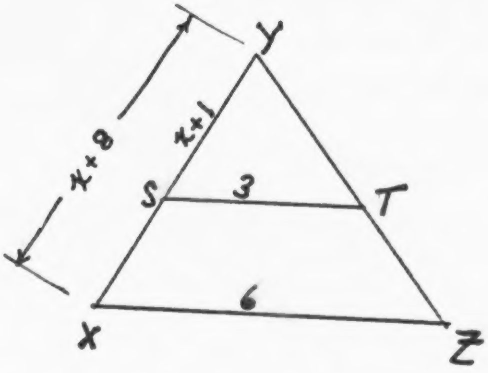
8.


Z
x+5
T
7
x
4
X
S
Y

9.


Y
4
S
x+2
x-1
5
X
T
Z

10.


Y
x+8
x+1
S
3
T
6
X
Z

SEGMENT PARALLEL TO SIDE OF TRIANGLE
ANSWERS TO HOMEWORK EXERCISES

1. $\frac{2}{4} = \frac{3}{BY}$

   6

2. $\frac{3}{7} = \frac{AY}{8}$

   24/7

3. $\frac{AX}{6} = \frac{6}{9}$

   4

4. $\frac{4}{x} = \frac{x}{8}$

   4 2

5. BY

6. BY

7. $\frac{3}{x-2} = \frac{3}{1}$

   3

8. $\frac{x}{4} = \frac{x+5}{7}$

   20/3

9. $\frac{x+2}{4} = \frac{x-1}{5}$

   not possible

10. $\frac{x+1}{x+8} = \frac{3}{6}$

    6

COMPUTER SOFTWARE PROGRAM REVIEW AND DESCRIPTION

TITLE: **THE GEOMETRIC SUPPOSER: QUADRILATERALS**

PUBLISHER:
Sunburst Communications Inc.
39 Washington Avenue
Pleasantville NY 10570

PRICE:		$99.00
	10-disk lab pack	$297.00

PIMMS RATING: Excellent

COMPUTER: Apple II+, IIc, IIe

PROGRAM IS APPROPRIATE FOR:

Courses: Geometry - grades 7,8

Ability level: low, middle, high

Format: class demonstration; discovery lab

Characteristics: disk independent, user- friendly, support materials

ADDITONAL PERIPHERALS NEEDED: none

REVIEW AND DESCRIPTION OF THE PROGRAM

GEOMETRIC SUPPOSER: QUADRILATERALS is one of four software packages which allows the user to explore the properties of geometric figures and make conjectures about those properties.

The program allows the user to draw a variety of different types of quadrilaterals and any segments and lines commonly associated with them. The user then has the ability to measure any angles, lengths, areas, perimeters, any distance between a point and a line, and any distance between two lines.

GEOMETRIC SUPPOSER: QUADRILATERALS can be used for classroom demonstrations, an example of which would be the classification of the different parallelograms by the relationships of sides, angles, diagonals, triangles formed by diagonals, etc.

The software also can be used in a discovery laboratory setting, an example of which would be investigation of the results when the median of a trapezoid is drawn. Students should be able to make conjectures about these facts and use the software to prove or disprove the conjectures -- or better, to learn facts that were not apparent at first.

The software is menu driven and disk independent. The user initiates the program by following the direction, "Press N to Start" where N refers to the menu choice NEW SHAPE. The user is immediately presented a different menu with the following choices:

1. Parallelogram
2. Trapezoid
3. Kite
4. Quads/Circles
5. Your Own

After the type of quadrilateral the user wishes to explore has been drawn on the screen, the user is given menu and sub-menu choices to help accomplish the prescribed task. The program manual gives a detailed description of each menu item.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: PROPERTIES OF PARALLELOGRAMS

OBJECTIVE:

to determine the properties of a parallelogram, rhombus, rectangle,and square

COURSE: Geometry

SOFTWARE PACKAGE: Geometric Supposer: Quadrilaterals

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

The student should:

- be able to use the software package **GEOMETRIC SUPPOSER: QUADRILATERALS**
- know how to name angles and segments
- recognize supplementary angles, right angles, and perpendicular lines
- know properties of parallel lines and relationships among angles formed by parallel lines and transversals

FORMAT: discovery laboratory

GENERAL DESCRIPTION OF THE LAB ACTIVITY

PROPERTIES OF PARALLELOGRAMS
LABORATORY EXERCISES

DIRECTIONS

Use the Supposer to draw a parallelogram, rectangle, rhombus, and square. For each figure you will determine the lengths of the four sides and the measures of the four angles.

1. PARALLELOGRAM (Random)

Draw a diagram of a parallelogram on the screen and label it. Copy it here.

Find: (the measure of each angle and each side)

∡ABC	____________________	$\overline{AB}$	____________________
∡BCD	____________________	$\overline{BC}$	____________________
∡CDA	____________________	$\overline{CD}$	____________________
∡DAB	____________________	$\overline{DA}$	____________________

a) What is true about opposite angles?

b) What is true about consecutive angles?

c) Name two relationships which seem to be true about opposite sides.

d) Write a definition for a parallelogram.

80

2. RECTANGLE

Draw a rectangle on the screen and label it. Copy it here.

Find: (the measure of each angle and each side)

∡ABC ____________________

∡BCD ____________________

∡CDA ____________________

∡DAB ____________________

$\overline{AB}$ ____________________

$\overline{BC}$ ____________________

$\overline{CD}$ ____________________

$\overline{DA}$ ____________________

a) What is true about all the angles of a rectangle?

b) Are the relationships that are true about the opposite sides of a rectangle the same as for the parallelogram?

c) Write a definition for a rectangle.

3. RHOMBUS

Draw a diagram of a rhombus on the screen and label it.
Copy it here.

Find: (the measure of each angle and side)

∡ABC ____________________

∡BCD ____________________

∡CDA ____________________

∡DAB ____________________

$\overline{AB}$ ____________________

$\overline{BC}$ ____________________

$\overline{CD}$ ____________________

$\overline{AD}$ ____________________

a) What is true about the opposite angles of a rhombus?

b) What is true about consecutive angles of a rhombus?

c) What is true about all the sides of a rhombus?

d) Write a definition for a rhombus.

4. SQUARE

Draw a diagram of a square on the screen and label it. Copy it here.

a) List all the facts you know about a square.

To confirm your conjectures, determine the measures of the angles and sides of the square you drew.

∡ABC ______________________ $\overline{AB}$ ______________________

∡BCD ______________________ $\overline{BC}$ ______________________

∡CDA ______________________ $\overline{CD}$ ______________________

∡DAB ______________________ $\overline{DA}$ ______________________

b) Write a definition for a square.

PROPERTIES OF PARALLELOGRAMS
ANSWERS TO LABORATORY EXERCISES

1. Parallelogram

    a) The opposite angles are equal.

    b) Consecutive angles are supplementary.

    c) Opposite sides are equal and parallel.

    d) A parallelogram is a quadrilateral with two pairs of parallel sides.

2. Rectangle

    a) All the angles measure 90 degrees.

    b) yes

    c) A rectangle is a parallelogram with four right angles.

3. Rhombus

    a) The opposite angles are equal.

    b) The consecutive angles are supplementary.

    c) The sides of a rhombus all have the same measure.

    d) A rhombus is a parallelogram with four equal sides.

4. Square

    a) All sides are equal.
    All angles measure 90 degrees.
    Opposite sides are parallel and equal.
    Opposite angles are equal.
    Consecutive angles are supplementary.

    b) A square is an equilateral rectangle.
    A square is an equiangular rhombus.

PROPERTIES OF PARALLELOGRAMS
HOMEWORK EXERCISES

1. Determine the lengths and angle measures required for ABCD to be a parallelogram.

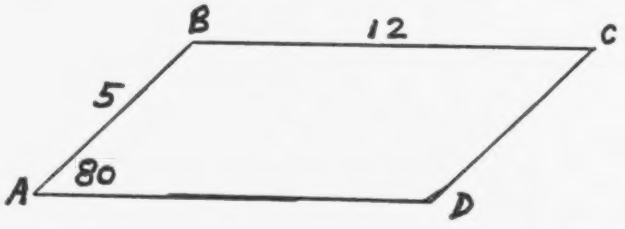
CD ________

AD ________

m∠ABC ________

m∠BCD ________

m∠CDA ________



Give the sum of the measures of the four angles: _____

2. Determine the lengths and angle measures required for ABCD to be a rectangle.

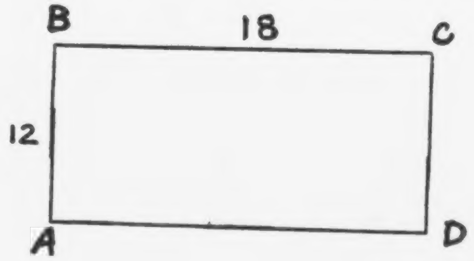
CD ________

AD ________

m∠ABC ________

m∠BCD ________

m∠CDA ________

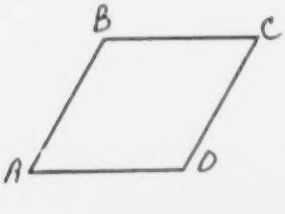


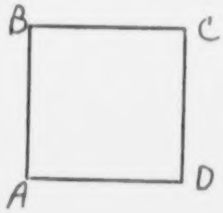
Give the sum of the measures of the four angles: _____

3. ABCD is a quadrilateral.

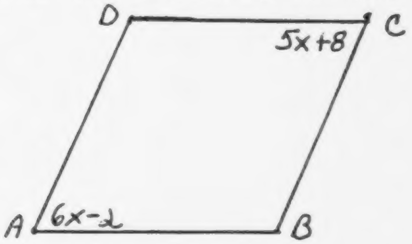
a. When the measure of ∠BAD is 82, what must be the measure of ∠ABC for ABCD to be a rhombus? _____

b. When AB = 8, what must be the length of $\overline{AD}$ for ABCD to be a square? _____

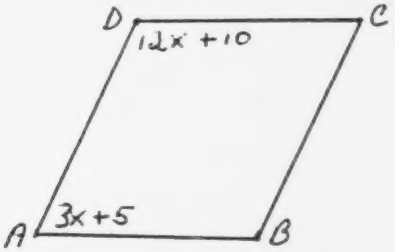




4. Find the measures of the angles of the parallelogram.

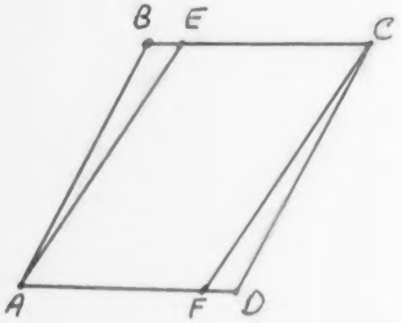

D
C
5x+8
A
6x-2
B

5. Find the measures of the angles of the rhombus.

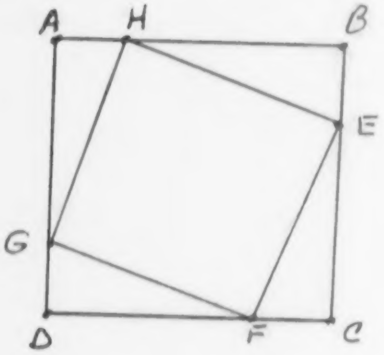

D
C
12x +10
A
3x+5
B

6. ABCD is a parallelogram.
AB = 2x + 6
DC = 5x - 12
AD = 4x-6
Show that ABCD is a rhombus.

7. Given: ABCD is a parallelogram
AECF is a parallelogram
Prove: $\triangle DCF \cong \triangle BAE$



8. Given: ABCD is a square
AH = DG = CF = BE
Prove: EFGH is a square



PROPERTIES OF PARALLELOGRAMS
ANSWERS TO HOMEWORK EXERCISES

1. $CD = 5$, $AD = 12$; $m\angle ABC = 100$, $m\angle BCD = 80$, $m\angle CDA = 100$
   Sum of 4 angles = 360.

2. $CD = 12$, $AD = 18$; $m\angle ABC = 90 = m\angle BCD = m\angle CDA$
   Sum of 4 angles = 360.

3. a. 98 b. 8

4. $6x - 2 = 5x + 8$ Four angles: 58, 122, 58, 122
   $x = 10$
   Check:
   $6(10) - 2 = 58$

5. $3x + 5 + 12x + 10 = 180$ Four angles: 38, 142, 38, 142
   $x = 11$
   Check:
   $3(11) + 5 + 12(11) + 10 = 180$

6. $AB = DC$ $AB = 18 = DC = AD$
   $2x + 6 = 5x - 12$
   $x = 6$

7. Suggested Proof:

1. $AB = DC$; $AE = FC$	1. Opposite sides are =
2. $m\angle ABE = m\angle CDF$	2. Opposite angles are =
3. $m\angle AEC = m\angle CFA$	3. Same
4. $m\angle BEA = m\angle DFC$	4. Supplements of = angles are =
5. $\triangle DCF \cong \triangle BAE$	5. AAS

8. Suggested Proof:

1. $AH = DG = CF = BE$	1. Given
2. $m\angle A = m\angle B = m\angle C = m\angle D$	2. Angles of Square are =.
3. $AG = BH = CE = DF$	3. ='s subtracted from ='s
4. $\triangle GAH \cong \triangle HBE \cong \triangle CEF \cong \triangle DFG$	4. SAS or LL
5. $HG = EH = FE = GF$	5. CPCTC
6. $m\angle 1 + m\angle 2 = 90$	6. Acute angle of right triangle
7. $m\angle 3 + m\angle 4 = 90$	7. Same
8 $m\angle 1 = m\angle 3$; $m\angle 2 = m\angle 4$	8. CPCTC
9. $2(m\angle 3) + 2(m\angle 2) = 180$	9. Addition and substitution
10. $m\angle 3 + m\angle 2 = 90$	10. Division
11. $m\angle HGF = 90$	11. Subtraction
Similar argument can be made for rest of angles.	
12. EFGH is a square.	12. All sides = All angles = 90

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: DIAGONALS OF PARALLELOGRAMS

OBJECTIVES:

- to determine the relationships that result when one diagonal is drawn in a parallelogram
- to determine the relationships that result when both diagonals are drawn in a parallelogram, rhombus, rectangle, and square

COURSE: Geometry

SOFTWARE PACKAGE: Geometric Supposer: Quadrilaterals

SUGGESTED TIME: two class periods

PREREQUISITE SKILLS/CONCEPTS:

Student should be able to

- use the software **GEOMETRIC SUPPOSER: QUADRILATERALS**
- recognize the diagonals of a quadrilateral
- recognize alternate interior angles formed by two parallel lines cut by a transversal

Student should

- know conditions necessary for congruent triangles
- understand concept of area

FORMAT: discovery laboratory

GENERAL DESCRIPTION OF THE LAB ACTIVITY

DIAGONAL OF A PARALLELOGRAM - One Diagonal
LABORATORY EXERCISES

DIRECTIONS:

Use the Supposer to draw a parallelogram and one diagonal of the parallelogram. Measure the four angles whose sides are the diagonal and a side of the parallelogram. Measure the areas of the two triangles formed when the diagonal is drawn. Repeat the exercise with a second parallelogram and then answer the given questions.

EXERCISES

1. PARALLELOGRAM 1

(NOTE: When drawing the diagonal, connect A to C to avoid confusion when reading the directions.)

Copy here the labelled diagram shown on the screen.

m∠BAC ____________________ Area of △ADC ________________

m∠DAC ____________________ Area of △CBA ________________

m∠DCA ____________________

m∠BCA ____________________

2. PARALLELOGRAM 2

Copy here the labelled diagram shown on the screen.

m∠BAC ____________ Area of △ADC ____________

m∠DAC ____________ Area of △CBA ____________

m∠DCA ____________

m∠BCA ____________

1. What statements can you make about the angles and triangles formed when diagonal AC is drawn?

2. What relationship exists between the diagonal and the angles whose vertices it contains?

3. What postulate or theorem could be used to demonstrate that the triangles are congruent? (e.g., SSS, SAS, ASA ...)

DIAGONALS OF PARALLELOGRAMS - Two Diagonals
LABORATORY EXERCISES

DIRECTIONS:

Use the Supposer to draw in both diagonals of the indicated type of parallelogram. Since all figures to be explored in this activity are parallelograms, the facts that applied in the first activity are still valid. The measures of the selected angles, areas of selected triangles, and lengths of selected segments will be determined.

For these exercises, use E to indicate the intersection of the diagonals.

1. PARALLELOGRAM

Copy here the labelled diagram shown on the screen.

Find the measures of the indicated sides, angles, and triangles.

AE ____________________

EC ____________________

DE ____________________

EB ____________________

AC ____________________

DB ____________________

∡AED ____________________

∡ABE ____________________

∡CBE ____________________

Area of △AED ____________________

Area of △CED ____________________

Using the data from the activity, decide whether the following statements are true or false.

1. The diagonals of a parallelogram are equal. ________
2. The diagonals of a parallelogram bisect each other. ______
3. The diagonals of a parallelogram bisect the angles of the parallelogram. _______
4. The diagonals of a parallelogram are perpendicular to each other. ________
5. The diagonals of a parallelogram form four triangles equal in area.
6. The diagonals of a parallelogram form four triangles that are congruent to each other.________

2. RHOMBUS

Copy here the labelled diagram shown on the screen.

Find the measures of the indicated sides, angles, and triangles.

AE ____________________

EC ____________________

DE ____________________

EB ____________________

AC ____________________

DB ____________________

∡AED ____________________________

∡ABE ____________________________

∡CBE ____________________________

Area of △AED ____________________

Area of △CED ____________________

Since a rhombus is a parallelogram, the valid statements in Section A are still true. Now look at the false statements in Section A and determine if they are true for a rhombus.

1. Which statements are now true? ____________________
2. Which statements continue to be false? ____________
3. Use the measure option (M) to find the area of rhombus ABCD.__________ Find the product of the diagonals of the rhombus.__________ Do you see any relationship? Explain.

(If a relationship is not apparent to you, draw a new rhombus and repeat steps 1- 3.)

3. RECTANGLE

Copy here the labelled diagram shown on the screen.

Find the measures of the indicated sides, angles and triangles.

AE ________________

EC ________________

DE ________________

EB ________________

AC ________________

DB ________________

∡ AED ________________________

∡ ABE ________________________

∡ CBE ________________________

Area of △ AED ________________

Area of △ CED ________________

Since a rectangle is also a parallelogram, the valid statements in Section A are still valid. Now look at the false statements in Section A and determine if they are true for a rectangle.

1. Which statements are now true? ____________________
2. Which statements continue to be false? ____________
3. Have all six statements now been satisfied by at least one of the figures? ____________
4. Use the measure option (M) to find the area of rectangle ABCD .__________ Now find the product of the diagonals.__________ Can the product of the diagonals be used to find the area of a rectangle? ____________
5. What lengths associated with the rectangle would you use to find the area? ______________________________
   Check that you are correct. __________________

4. SQUARE

Copy here the labelled diagram shown on the screen.

The square is considered to be the perfect quadrilateral; it is a parallelogram, rhombus, and rectangle. Therefore, all six statements in Section A should be true for a square. Find and use the data for a square to verify this.

AE ________________

EC ________________

DE ________________

EB ________________

AC ________________

DB ________________

∡ AED ______________________

∡ ABE ______________________

∡ CBE ______________________

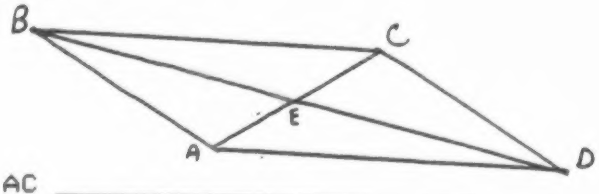
Area of △ AED ________________

Area of △ CED ________________

DIAGONALS OF A PARALLELOGRAM
HOMEWORK EXERCISES

1. Use the given information to determine the missing lengths and angle measures, if possible .

a. Given: ABCD is a parallelogram



m∠ADE = 53
m∠ABC = 80
AE = 6
BD = 10

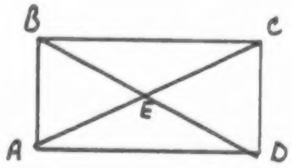
m∠CDE ______________ AC ______________

m∠CBD ______________ DE ______________

m∠DAE ______________ AD ______________

m∠DEA ______________

b. Given: ABCD is a rectangle



m∠ADE = 53
AE = 6

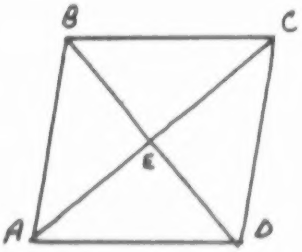
m∠CDE ______________ AC ______________

m∠CBD ______________ DE ______________

m∠DAE ______________ AD ______________

m∠DEA ______________

c. Given: ABCD is a rhombus



m∠ADE = 53
AE = 3
BD = 8

m∠CDE ______________ AC ______________

m∠CBD ______________ DE ______________

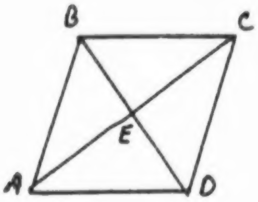
m∠DAE ______________ AD ______________

m∠DEA ______________

2. ABCD is a rhombus

$m\angle AED = 5x - 5$
$m\angle ABC = 3x + 3$

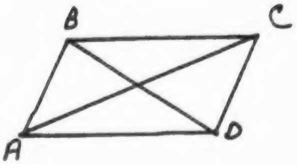
$m\angle ACB =$ __________



3. ABCD is a parallelogram

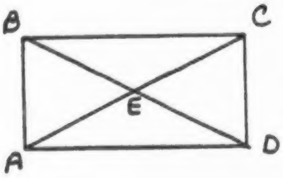
AB = 2x + 18
AC = 5x + 4

DC = 3x + 12
BD = 7x - 8



Show that ABCD is a rectangle.

4. Given: ABCD is a rectangle
Prove: △ABE is isosceles



5. On the basis of your investigation, indicate TRUE or FALSE.

a. Every rectangle is a parallelogram. __________

b. Some rhombuses are squares. __________

c. Every square is a rhombus. __________

d. Every rhombus is a rectangle. __________

e. The diagonals of a rectangle are perpendicular. ______

f. Every rhombus is a square. __________

g. A rhombus with congruent diagonals is a square. ______

h. A parallelogram with perpendicular diagonals is a rhombus. __________

DIAGONALS OF A PARALLELOGRAM
ANSWERS TO HOMEWORK EXERCISES

1. a. $m\angle CDE = 27$ AC = 12
$m\angle CBD = 53$ DE = 5
$m\angle DAE$ (not possible) AD (not possible)
$m\angle DEA$ (np)

b. $m\angle CDE = 37$ AC = 12
$m\angle CBD = 53$ DE = 6
$m\angle DAE = 53$ AD (np)
$m\angle DEA = 74$

c. $m\angle CDE = 53$ CA = 6
$m\angle CBD = 53$ DE = 4
$m\angle DAE = 37$ AD = 5
$m\angle DEA = 90$

2. $5X - 5 = 90$
$X = 19$

$m\angle ABC = 3(19) + 3 = 60$

$m\angle ACB = 60$ because $\triangle ABC$ is equilateral

3. AB = CD so $2x + 18 = 3x + 12$
$x = 6$

$AC = 5(6) + 4 = 34$
$BD = 7(6) - 8 = 34$

AC = BD, therefore ABCD is a rectangle (equal diagonals)

4. Since the diagonals of a rectangle are equal and the diagonals of any parallelogram bisect each other, BE = AE, and $\triangle ABE$ is isosceles.

5. a. True b. True c. True
d. False e. False f. False
g. True h. True

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: MEDIAN OF A TRAPEZOID

OBJECTIVE:

to determine for trapezoids the relationship between the median and the bases

COURSE : Geometry

SOFTWARE PACKAGE: Geometric Supposer: Quadrilaterals

SUGGESTED TIME: one class period

PREREQUISITE/REQUISITE SKILLS:

The student should know:

- how to use **GEOMETRIC SUPPOSER: QUADRILATERALS**
- conditions necessary for lines to be parallel
- how to draw the median of a trapezoid and know which sides of the trapezoid are "the bases" and which sides are "the sides"
- the formula for finding the area of a trapezoid: A = h(base 1 + base 2)/2

FORMAT: discovery laboratory

GENERAL DESCRIPTION OF THE LAB ACTIVITY

MEDIAN OF A TRAPEZOID
LABORATORY EXERCISES

DIRECTIONS:

Use the Supposer to draw a trapezoid and its median. It is important to locate the midpoint of BC first, then the midpoint of AD. To draw the median: select LABEL Option 2 and SUBDIVIDE THE SEGMENT Option 2 (to subdivide a segment into two parts). This procedure gives the midpoint of a side. Repeat the steps to find the midpoint of the other side. The construction is completed by drawing the segment joining the midpoints.

There are three menu choices for the exploration of trapezoids: RANDOM, ISOSCELES, RIGHT ANGLE. We shall explore each.

EXERCISES

1. RANDOM

Copy here the labelled diagram shown on the screen.

Find the measures of the indicated sides and angles.

AB ____________________ ∡BEF ____________________

CD ____________________ ∡ECD ____________________

EF ____________________ ∡EBA ____________________

2. ISOSCELES

Copy here the labelled diagram shown on the screen.

Find the measures of the indicated sides and angles.

AB ____________________ ∡ BEF ____________________

CD ____________________ ∡ ECD ____________________

EF ____________________ ∡ EBA ____________________

3. RIGHT ANGLE

Copy here the labelled diagram shown on the screen.

Find the measures of the indicated sides and angles.

AB ____________________ ∡ BEF ____________________

CD ____________________ ∡ ECD ____________________

EF ____________________ ∡ EBA ____________________

4a. For each case, add the measures of the two bases and compare the sum to the length of the median.

Random: Sum __________ Median__________

Isosceles: Sum __________ Median __________

Right: Sum __________ Median __________

What statement can you make about the length of the median and the lengths of the two bases?

b. Compare the measures of angle BEF and angle ECD. What name is given a pair of angles which are positioned in this manner when two lines are cut by a transversal?

What can be said about lines EF and CD? Why?

c. Add the measures of angles BEF and EBA. ___________
What can be said about lines EF and AB? Why?

5. Draw a NEW (N) random trapezoid and draw in the median. Draw in an altitude from either A or B. The steps are:

Draw (1)
Perpendicular (6)
Through Point (A or B)
To line CD
Length define by (2)
Intersection with segment CD and (RETURN)

Measure.

$\overline{AB}$ ________________ $\overline{CD}$ ________________

$\overline{EF}$ ________________ Altitude ________________

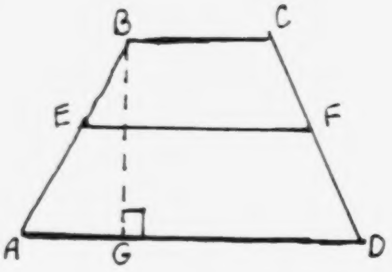
Find the area of the trapezoid by using the conventional formula: A = h(base 1 + base 2)/2

Now multiply the length of the altitude by the length of the median.

Compare the results. Explain.

MEDIAN OF A TRAPEZOID
HOMEWORK EXERCISES

1. ABCD is a trapezoid.
   $\overline{EF}$ is the median.



AD = 18
BG = 18

BC = 12
m∠BAG = 62

Find the measure.

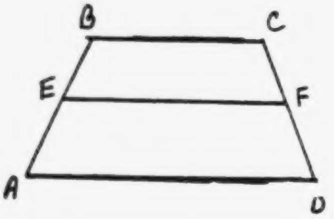
EF ____________

∡AEF ____________

Area of ABCD ____________

2. ABCD is an isosceles trapezoid.

EF is the median



AD = 20
m∠BAD = 70

BC = 15

Find the measure.

EF ____________

∡CDA ____________

∡CFE ____________

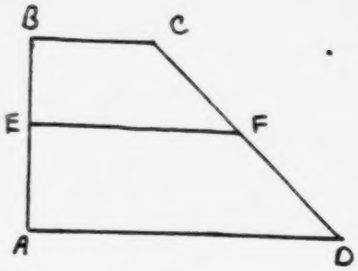
Draw perpendiculars from B and C to $\overline{AD}$ and label them $\overline{BG}$ and $\overline{CH}$.

GH ____________

AG ____________

Prove: $\triangle ABG \cong \triangle DCH$

3. $\underline{AB}$CD is a trapezoid with right angle BAD. $\overline{EF}$ is the median.



BC = 60
m∠CFE = 50

AD = 80
EB = 20

Find the measure.

EF ___________

∡EFD ___________

∡BEF ___________

Draw perpendicular $\overline{CG}$ to $\overline{AD}$.

AG ___________

GD ___________

Area of △CGD ___________

Area of ABCD ___________

MEDIAN OF A TRAPEZOID
ANSWERS TO HOMEWORK EXERCISES

1. EF = 15 $m\angle AEF = 118$

area of ABCD = 170

2. EF = 17.5 $m\angle CDA = 70$

$m\angle CFE = 70$ GH = 15

AG = 2.5

Proof:

1. AB = CD	1. isosceles trapezoid
2. $\angle BAG \cong \angle CDH$	2. same
3. $\triangle ABG \cong \angle DCH$	3. HA

3. EF = 70 $m\angle EFD = 130$

$m\angle BEF = 90$

AG = 60 GD = 20

area of $\triangle CGD$ = 400 area of ABCD = 2800

COMPUTER SOFTWARE PROGRAM REVIEW AND DESCRIPTION

TITLE: **SUPERPLOT**

PUBLISHER: EduSoft
P.O. Box 2560
Berkeley CA 94702

PRICE: $49.95
site license $35.00

COMPUTERS: Apple II, II+, IIc, IIe

PIMMS RATING: Good

PROGRAM IS APPROPRIATE FOR:

Course: any course in which graphs of functions are presented
Ability level: average to high

Format: class demonstration/discovery lab

Characteristics: disk dependent, user-friendly,graphics utility, directions booklet

ADDITIONAL PERIPHERALS NEEDED: color monitor preferred

REVIEW AND DESCRIPTION OF THE SOFTWARE:

SUPERPLOT is an easy-to-use, extremely versatile graphing utility. It allows the user to graph almost any explicit function. (One drawback is that SUPERPLOT does not handle roots of negative numbers even when the index is an odd number. Another drawback is that there is no option for printing a graph directly from the screen.)

Five functions can be graphed on one set of coordinate axes. User input is rendered in conventional algebraic notation rather than in BASIC notation. The user should be aware that to indicate the product of a fraction and a variable, the fraction must be given in parentheses and the multiplication given by *, the conventional BASIC symbol, although * prints as a dot on the screen.

The software allows the user to easily scroll a graph left, right, up, or down. With each shift, the labeled domain and range on the axes are automatically changed to accomodate the new position of the graph on the screen. The user also may zoom in on any section of the graph or expand the graph. Again, the domain and range are changed automatically.

For algebraic functions the domain is initially set for -10 to 10, and the the range is set for -7 to 7. For trig functions, the initial domain is set for 0 to 2 pi and the range is set for -2 to 2. The user may change the settings at any time.

A sound option provides a rising pitch when an increasing section of the graph is drawn and a falling pitch when a decreasing section of the graph is drawn. The sound component can be turned off by the user. Another option provides for the display of graphs in either line mode or dot mode. On-screen help is provided.

A User's Guide accompanies the software and gives detailed information about the scrolling, zooming, and expanding options as well as special input procedures.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: GRAPHING INVERSE FUNCTIONS

OBJECTIVE:

to determine the relationship between a graph of a function and its inverse

COURSES: Algebra II, Pre-Calculus

SOFTWARE PACKAGE: SUPERPLOT (EduSoft)

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

The student should:

- be able to use the SUPERPLOT software package
- be able to find the x- and y-intercepts of a line
- be able to find the inverse of a function algebraically by interchanging the roles of x and y, then transforming the resulting equation to give y
- understand the definition of line symmetry
- know that a function has an inverse only when there there is a one-to-one correspondence between the elements of the domain and elements of the range

FORMAT: discovery laboratory

GENERAL DESCRIPTION OF THE LAB ACTIVITY

In this lesson SUPERPLOT is used to draw the graphs of a function and its inverse on the same coordinate axes. Examples include linear and quadratic functions. Optional exercises are provided for students who have studied transcendental functions.

GRAPHING INVERSE FUNCTIONS
LABORATORY EXERCISES

1. Find the inverse of $y = 2x - 3$ by interchanging the roles of x and y and transforming the resulting equation to give y.

Use SUPERPLOT to graph $y = 2x - 3$ and its inverse on the same coordinate axes. Find the y-intercept for $y = 2x - 3$ from the graph. _____ Give the x-intercept for the graph of the inverse. _____

Now find the y-intercept for the inverse ___________ and the x-intercept for the given function. ___________

Compare the y-intercept of the given function and the x-intercept of the inverse. Also compare the x-intercept of the original function and the y-intercept of the inverse. What appears to be true?

When (6,9) is a point in the graph of the original function, verify that (9,6) is a point in the inverse.

(As a check on your work to this point, the inverse of $y = 2x - 3$ is $y = (1/2)x + 3/2$.)

When the graph of the function and its inverse are correctly shown, try to determine a line of symmetry for the graphs of the function and its inverse. Give its equation: ____________________ Now graph your "guess function" on the axes with the other two functions. Adjust your guess, if necessary, until you are satisfied that you have found the correct symmetry line.

Erase all graphs before proceeding to the next exercise.

108

2. Find the inverse of $y = -4x + 5$.

Graph $y = -4x + 5$ and its inverse on the same set of coordinate axes.

As in Exercise 1, find the indicated intercepts from the graphs.

Function: y-intercept _______ Inverse: x-intercept _____

Inverse: y-intercept _______ Function: x-intercept_____

Again compare the y-intercept of the function with the x-intercept of the inverse as well as the x-intercept of the function and the y-intercept of the inverse. If the pairs which you compared are not of the form (a,b),(b,a) recheck your steps in finding the inverse.

When the function and the inverse are correct, and the graphs are shown correctly on the screen, again determine a straight line to which the graphs of the function and its inverse are symmetric. Write an equation for this line of symmetry. _________ Compare this equation with the one you determined in Exercise 1.

Erase all graphs before going on to the next exercise.

3. Find the inverse of $y = x^2 + 2$.
[If you make no errors, your "inverse function" is given by $y = +\sqrt{x - 2}$ and $y = -\sqrt{x - 2}$.]

Now graph these two functions along with $y=x$ on the same axes. [Within the program, use Q for square root and x^2 for x^2 ; thus, Q(x-2) and -Q(x-2) are needed to graph the "inverse".]

Having done this, the display on the screen shows the graphs of the function $y = x^2 + 2$ and its "inverse" which is a relation consisting of the two functions $y = +\sqrt{x - 2}$ and $y = -\sqrt{x - 2}$. Note the relationship of $y=x$ to the graphs. Is $y=x^2$ a one-to-one function? Is the "inverse" one-to-one?

Erase all graphs before proceeding.

4. Find the inverse of $y = \sqrt{x - 2}$.

The result should be $y = x^2 + 2$. Now plot $y = \sqrt{x - 2}$ [i.e., Q(x-2) within the program], $y = x^2 + 2$, and $y = x$ on the same coordinate axes.

The function and its "inverse" do not appear to be symmetrical to the line $y = x$. Explain what is wrong and why.

[The portion of the graph of $y = x^2 + 2$ to the left of the y-axis ($x < 0$) is not in the graph of the inverse of $y = \sqrt{x - 2}$. (Check the range of $y = \sqrt{x - 2}$ to verify this.)]

Give the point where the graph of $y = x^2 + 2$ intersects the y-axis. __________ Give the point where the graph of $y = x - 2$ intersects the x-axis. __________ Again, are these points of the form (0,a) and (a,0)? __________

Give the symmetry line for the graphs on the screen.

[Exercise 5 is for students who have studied exponential and logarithmic functions.]

5. Graph the pair of functions along with the line $y = x$ on the same coordinate axes.

   a. $y = \ln x$, $y = e^x$

   b. $y = \log x$, $y = 10^x$

   c. $y = \ln (x + 2)$, $y = e^x - 2$

   d. $y = x^3$, $y = x^{(1/3)}$

      (Note: $y = x^{(1/3)}$ must be entered in two parts: $y = x^{(1/3)}$ and $y = -(-x)^{(1/3)}$.

GRAPHING INVERSE FUNCTIONS
ANSWERS TO LABORATORY EXERCISES

1. function, f: $y = 2x - 3$
   inverse, f^{-1}: $x = 2y - 3$
   $x + 3 = 2y$
   $(x + 3)/2 = y$

   y-intercept (0,-3); x-intercept (-3,0)
   y-intercept (0,3/2); x-intercept (3/2,0)

   For a y-intercept in the form (a,b),
   the x-intercept is (b,a).

   (9,6) is in the inverse because $(9 + 3)/2 = 6$

   Symmetry line: $y = x$.

2. function, f: $y = -4x + 5$
   inverse, f^{-1}: $x = -4y + 5$
   $x + 5 = -4y$
   $(x + 5)/-4 = y$

   Function: y-intercept (0,5) Inverse: x-intercept (5,0)
   Inverse: y-intercept (0,-5/4)Function:x-intercept(-5/4,0)
   Symmetry line: $y = x$

3. function, f: $y = x^2 + 2$
   inverse, f^{-1}: $x = y^2 + 2$
   $x - 2 = y^2$
   $y = \sqrt{x - 2}$ or $y = -\sqrt{x - 2}$

   The function is not 1-to-1. The "inverse" we have found is not 1-to-1.

4. function, f: $y = x - 2$
   inverse, f^{-1}: $x = y - 2$
   $x^2 = y - 2$
   $x^2 + 2 = y$

   The graphs of the function and its inverse each must be 1-to-1 (have a one-to-one correspondence between the elements of the domain and the range). In Ex.3 we saw that neither the function nor the "inverse" we found is 1-to-1; hence, the graphs do not exhibit the required symmetry. However, $y = \sqrt{x - 2}$ is 1-to-1 with domain x=>2 and range y => 0 and has as its inverse $y = x^2 + 2$ with domain x => 0 and range y => 2.

   (0,2); (2,0); yes; symmetry line: $y = x$

GRAPHING INVERSE FUNCTIONS
HOMEWORK EXERCISES

DIRECTIONS: Find the inverse of the function algebraically.

1. $y = 3x + 5$

2. $y = (2/3)x - 6$

3. $y = 2x^2 - 5$

4. $y = \ x + 6$

5. Given:

x	y
-1	-5
0	-3
1	-1
2	1
3	3

Give 5 ordered pairs of the inverse.

x	y

Graph both sets of ordered pairs on the same set of axes.
Draw the line of symmetry and write its equation.

6. Follow the directions for Exercise 5.

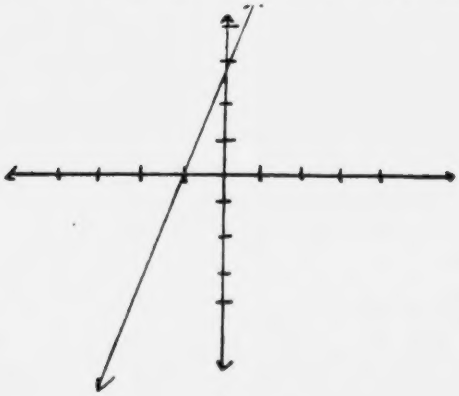
Given:

x	y
-2	9
-1	3
0	1
1	3
2	9

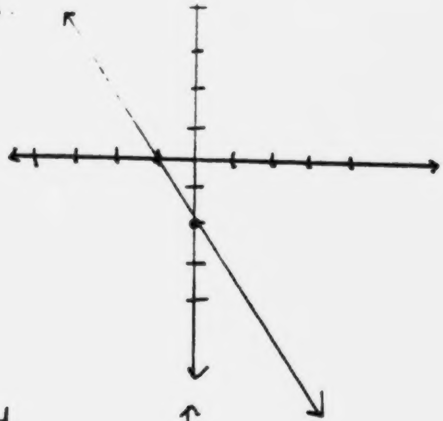
x	y

7. Sketch the graph of the inverse and the symmetry line.

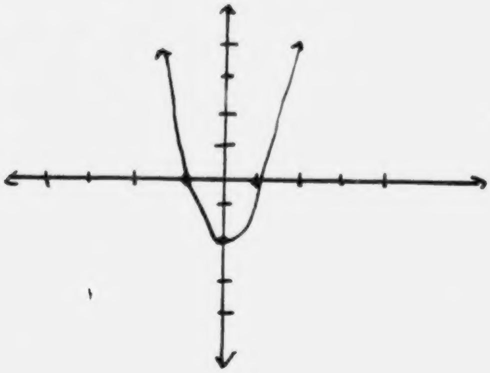
a.



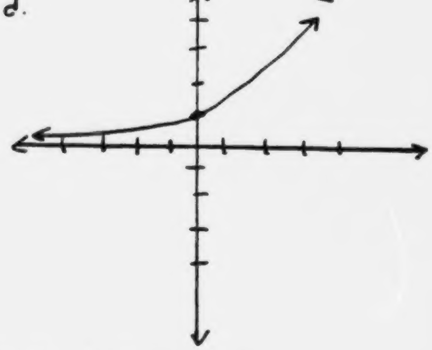
b.



c.



d.



8. Graph $y = (1/2)x - 1$ and its inverse $y = 2x + 2$ on the same set of coordinate axes. Find four ordered pairs in the form (a,b) for one graph and (b,a) for the other graph. Connect each (a,b) to the corresponding (b,a). Explain what the line $y = x$ has to do with these segments.

GRAPHING INVERSE FUNCTIONS
ANSWERS TO HOMEWORK EXERCISES

1. Given: $y = 3x + 5$
   Solution:
   f: $x = 3y + 5$
   f^{-1}: $x - 5 = 3y$
   f^{-1}: $(x - 5)/3 = y$

2. Given: $y = (2/3)x - 6$
   Solution:
   $x = (2/3)y - 6$
   $x + 6 = (2/3)y$
   $(3/2)(x + 6) = y$

3. Given: $y = 2x^2 - 5$
   Solution:
   f: $x = 2y^2 - 5$
   f^{-1}: $x + 5 = 2y^2$
   $(x + 5)/2 = y^2$

   f^{-1}: $y = \sqrt{(x + 5)/2}$ or $y = -\sqrt{(x + 5)/2}$

4. Given: $y = \sqrt{x + 6}$
   Solution:
   $x = \sqrt{y + 6}$
   $x^2 = y + 6$
   $x^2 - 6 = y$

5. Solution:

x	y
-5	-1
-3	0
-1	1
1	2
3	3

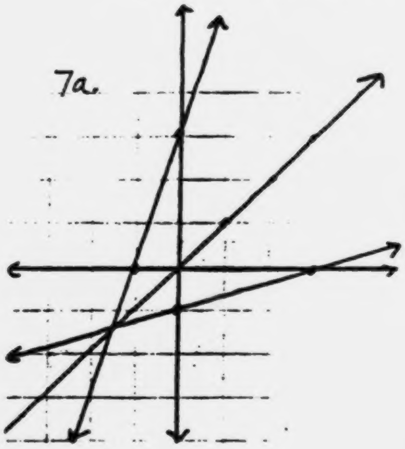
Eq. for symmetry line: $y = x$

6. Solution.

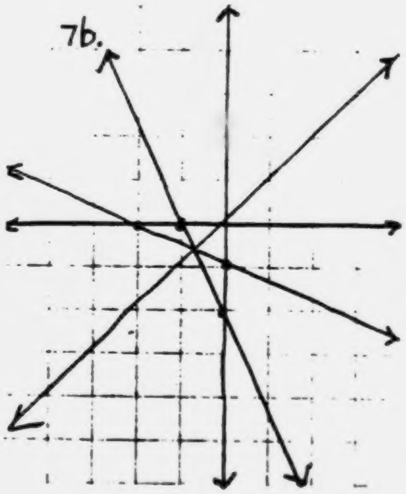
x	y
9	-2
3	-1
1	0
3	1
9	2

Eq. for symmetry line: $y=x$

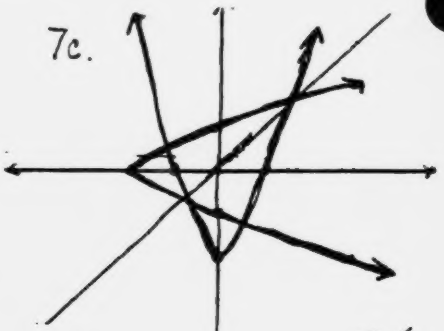
7a.



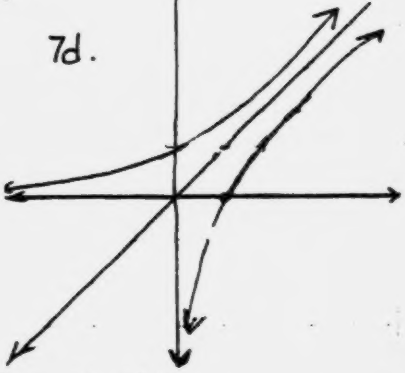
7b.



7c.



7d.



8. Examples of solutions:

Function: (0,-1); (2,0); (4,1); (6,2)
Inverse: (-1,0); (0,2); (1,4); (2,6)

The symmetry line is the perpendicular bisector of all segments between (a,b) and (b,a).

COMPUTER SOFTWARE PACKAGE REVIEW AND DESCRIPTION

TITLE: INTRODUCTORY STATISTICS SOFTWARE PACKAGE

PUBLISHER: ADDISON-WESLEY PUBLISHING CO.
JACOB WAY, READING, MA 01867

PRICE: $15.96

COMPUTERS: Apple II+, IIe, IIc

PIMMS' RATING: Very Good

PROGRAM IS APPROPRIATE FOR

Course: Probability & Statistics, Gr. 10 - 12

Ability level: middle,high

Format: discovery lab

CHARACTERISTICS:

documentation, support materials, user-friendly, on-screen help, management system, sequence control, graphics, edit function, data can be saved, disk-dependent to save data

ADDITIONAL PERIPHERALS (desirable but not needed):

"Grappler+" printer interface card to print screen graphics

REVIEW AND DESCRIPTION OF THE PROGRAM:

The **Introductory Statistics Package** is a set of eleven easy-to-use programs that complement most introductory statistics courses. The set of programs carries out tedious statistical computations and provides for graphical representation of data. When used with teacher-generated lessons, the package provides an excellent opportunity for students to discover or reinforce statistical concepts and to experience the computational efficiency possible with computers.

The programs are extremely user-friendly, enabling most students to use them with a minimum of instruction. Limitations of each program are clearly stated at the beginning of each module. The only annoying feature of the package is that when a user wishes to "rework" live or stored data (e.g., graph it again using a different class width) it is necessary to reload and resort the data.

None of the programs in the package requires a printer. To produce hard copy (printed) output, an Epson printer with a Grappler+ card works well. An Apple Imagewriter equipped with an Apple Super Serial Card may be used to produce non-graphical output; although there will be some misalignment of tabulated information, the output will be readable.

The user's manual is well written, and contains problem sets, some of which have been modified and included in the following lessons.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: MEAN, VARIANCE, AND STANDARD DEVIATION

OBJECTIVES:

to use a commercial computer program to calculate the mean, variance, and standard deviation of a data set

to investigate the effect on x and s of

- adding a constant to each score in a set
- multiplying each score by a constant

COURSE: Statistics

SOFTWARE PACKAGE: Introductory Statistics

SUGGESTED TIME: one class period for lab exercises
additional time needed for follow-up exs.

PREREQUISITE SKILLS/CONCEPTS:

familiarity with use of the software package

knowledge of definitions of mean, variance, standard deviation

FORMAT: discovery lab

GENERAL DESCRIPTION OF THE LABORATORY ACTIVITY:

MEAN, VARIANCE, AND STANDARD DEVIATION
LABORATORY EXERCISES

DIRECTIONS:

Boot the Introductory Statistics disk. Select Mean and Standard Deviation from the menu (# 3). Read the program limitations carefully.

Use the Mean and Standard Deviation program. Calculate the mean, variance, and standard deviation for these scores: 72, 73, 76, 76,78.

mean ($\bar{x}$) = ____ variance (s^2) = ____ std. dev.(s) = ____

[To rerun this program, press the R key.]

EXERCISE 1
Use the data above.

a) Add the constant 25 to each score. The new scores are: 97, 98, 101, 101, 103.

Recompute the statistical variables as above and record:

$\bar{x}$ = ________ s^2 = ________ s = ________

b) Subtract the constant 25 from each of the original scores. List the revised scores here:

Again, recompute the statistical variables. Record.

$\bar{x}$ = ________ s^2 = ________ s = ________

c) Multiply (calculator allowed) each of the original: scores by 25. List the revised scores:

Recompute, as above.

$\bar{x}$ = ________ s^2 = ________ s = ________

d) Divide each of the original scores by 25. List the revised scores (rounded to the nearest hundredth):

Recompute, as above.

$\bar{x}$ = ________ s^2 = ________ s = ________

EXERCISE 2

Use the Mean and Standard Deviation program. Calculate the mean, variance, and standard deviation again based on the original data in Exercise 1 (72,73,76,76,78), but for items a) - d) use 17 instead of 25. Do you see any relationship between your original results and the new results? If so, try other constants to test your conjecture and then state your conclusions.

EXERCISE 3

a) Find the mean and std. deviation for these five large numbers.

5,167,172
5,167,173
5,167,176
5,167,176
5,167,178

What happened after you entered the first number?

Adjust the data; then use one of the rules discovered in Exercise 1 to calculate the mean and std. deviation.

$\bar{x}$ = ________ s = ________

EXERCISE 4

NASA needs to purchase timing devices to be used in rocket components.The agency tested five timers from each of two manufacturers. The timers were set to activate 600 seconds (10 minutes) after blast-off.

		Activation time (seconds)				
Manufacturer	A	605	610	600	590	595
	B	603	605	597	595	600

Compute the mean and std. deviation for each manufacturer's product.

		mean	std. dev.
Manufacturer	A	_____	_____
	B	_____	_____

MEAN, VARIANCE, AND STANDARD DEVIATION
HOMEWORK EXERCISES

1. Look over the results you obtained in parts a thru e in Laboratory Exercise 1. Complete the sentences to help summarize what you have learned.

   If a set of numbers has mean $\bar{x}$ and std. deviation s, then

   a) when a constant k is added to each number in the set the new mean will be x + _____; the std. deviation will be _______.

   b) When a constant k is subtracted from each number in the set, the new mean will be x +_______; the std. deviation will be _____.

   c) When each number in the set is multiplied by a constant k, the new mean will be x + _______; the std. deviation will be _____.

   d) When each number in the set is divided by a constant k the new mean will be x + _____; the std. deviation will be _____.

2. A set of data has mean 6 and standard deviation 2. Give the new mean and standard deviation when

   a) 3 is subtracted from each score. $\bar{x}$ = _____ s = ____

   b) each score is multiplied by 1/2. $\bar{x}$ = _____ s = ____

   c) each score is multiplied by 10 , then diminished by 5.

   $\bar{x}$ = _____ s = ____

3. a) Explain the procedure you used in Lab Exercise 2 to calculate the mean and standard deviation.

   b) Why couldn't you simply compute $\bar{x}$ and s by entering the given numbers into the program?

4. Use the means and standard deviations you obtained in Lab Ex.3 . From which manufacturer would you recommend that NASA buy the timers? Justify your answer (in complete sentences, of course).

MEAN, VARIANCE, AND STANDARD DEVIATION
ANSWERS TO LABORATORY EXERCISES

		$\bar{x}$	s^2	s
Ex. 1				
	a	75	4.8	2.191
	b	50	4.8	2.191
	c	1875	3000	54.772
	d	3	.008	.088
Ex. 2		5,167,175		2.191
Ex. 3	A	600		7.071
	B	600		3.688

MEAN, VARIANCE, AND STANDARD DEVIATION
ANSWERS TO HOMEWORK EXERCISES

1. a) $\bar{x}$ + k, unchanged b) $\bar{x}$ − k, unchanged c) k$\bar{x}$, ks

   d) $\bar{x}$/k, s/k

2. a) $\bar{x}$ = 3, s = 2 b) $\bar{x}$ = 3, s = 1 c) $\bar{x}$ = 55, s = 20

3. a) From each score subtract 5,000,000. Each adjusted score is then a 6-digit number. The software program gives mean 167,175_ and std. dev. 3.578. The true sample mean is $\bar{x}$ + 5,000,000, or 5,167,175. The true sample std. dev. is 2.191. (Students may have other legitimate methods for obtaining these results.)

   b) The numbers are too large -- i.e., they contain more than 6 digits.

4. Other things being equal, NASA should purchase the timers from Manufacturer B. Although both samples had mean time before activation of 600 sec., the smaller std. deviation for Sample B indicates that a timer from that manufacturer is more likely to activate nearer the 600-sec. mark.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: DISTRIBUTION SHAPES

OBJECTIVES:

to use a commercially prepared program to enter a set of scores and construct from them a frequency table and histogram

to identify frequency distributions by the shapes of their histograms

to calculate and locate the mean for a distribution

COURSE: Statistics

SOFTWARE PACKAGE NEEDED: Introductory Statistics

SUGGESTED TIME:

one class period for data entry and gaining information about each frequency distribution

additional time needed for follow-up questions

PREREQUISITE SKILLS/CONCEPTS:

be familiar with use of the software package

recognize the shape of theoretical distributions: normal, bimodal, uniform, skewed

be able to construct a histogram and frequency polygon from tabular data

be able to calculate the probability of a simple event

FORMAT: computer-enhanced calculations

GENERAL DESCRIPTION OF THE LABORATORY ACTIVITY

DISTRIBUTION SHAPES
LABORATORY EXERCISES

DIRECTIONS:

Boot the Introductory Statistics disk. From its menu select Histogram and Frequency Curves (item 2). Be sure to read the program limitations carefully.

EXERCISE 1

Here are the weights of 30 football players.

180	232	233	235	257	237
230	215	230	238	254	232
231	218	242	240	245	242
225	200	253	237	240	201
228	199	228	240	221	243

a) Enter the data and save it for future use as Data Set A. [If your computer is equipped with a printer, you may ask the program to give a printout of this input data. Since some printers do not work well with this software, check with your teacher.]

b) When the program asks "DO YOU WANT THE COMPUTER TO SELECT THE INTERVAL SIZE?(Y/N)", type N. Then to indicate that you want Interval Size 10, type 10. [Here interval size means the width of each class interval, not the number of intervals you desire.]

c) When the frequency table appears on the screen, copy the information onto a Lab Record Sheet.

d) Record the type of frequency distribution displayed on the screen.

EXERCISE 2

The following is a list of student test scores. Carry out steps a) - d) for these data, using interval size 3. Save as Data Set B.Record the frequency table on a Lab Record Sheet.

68	63	65	67	64	76	73	67	67	68	65	61	60	65	64
66	64	65	75	68	70	70	64	70	72	66	66	62	68	69
71	65	61	68	66	68	63	65	69	68	64	65	67	69	71
69	71	65	69	58										

EXERCISE 3

The last digit from each of 100 telephone numbers in a telephone directory is listed below. Carry out steps a) - d) for these data, letting the program pick the interval size. Save as Data Set C. Record the frequency table on a Lab Record Sheet.

3	3	8	3	5	8	9	2	8	5
4	6	1	4	1	9	8	5	0	1
2	7	9	7	2	7	8	0	2	4
8	3	5	0	9	6	1	7	6	1
9	7	6	8	2	7	3	7	7	4
0	2	3	3	1	1	5	2	0	9
8	5	3	3	7	8	3	6	3	2
9	0	7	2	0	6	3	7	1	6
2	4	6	9	9	1	5	6	7	5
2	0	4	5	6	3	1	5	7	5

EXERCISE 4

American Statistician is a professional periodical published monthly. In a survey, 100 randomly-selected subscribers were asked, "How many of the 12 issues published this past year did you read?" The responses are shown below. Carry out steps a) - d) for these data, letting the program pick the interval size. Save as Data Set D. Record the frequency table on a Lab Record Sheet.

12	10	11	0	11	12	1	12	12	11
0	11	0	12	12	11	1	12	11	1
2	0	11	0	11	12	11	1	0	2
1	0	10	0	12	12	4	12	0	12
12	10	11	8	12	0	1	2	0	0
12	12	0	5	1	0	11	0	11	11
11	11	11	0	0	1	10	0	0	0
12	0	12	1	0	12	2	12	11	0
12	12	9	10	11	2	1	12	0	11
1	11	12	3	12	0	12	10	10	1

DISTRIBUTION SHAPES

LAB RECORD SHEET

Data for Exercise #____

Frequency Table

Interval#	Class Limits	Frequency	Cum.% (C%)
* 1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

* Note: The program lists the intervals in reverse order (12-1). Be sure you record the data in the correct order.

LAB RECORD SHEET

Data for Exercise #____

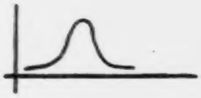
Frequency Table

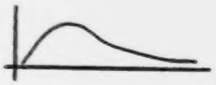
Interval#	Class Limits	Frequency	Cum.% (C%)
* 1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			

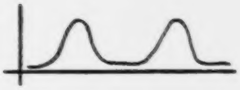
* Note: The program lists the intervals in reverse order (12-1). Be sure you record the data in the correct order.

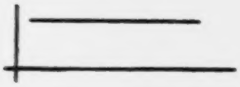
DISTRIBUTION SHAPES
HOMEWORK EXERCISES

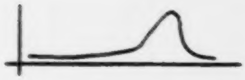
1. Match the letter of the correct description with the graph.

a)


b)


c)


d)


e)


U. uniform distribution

L. distribution skewed left

R. distribution skewed right

N. normal distribution

B. bimodal distribution

2. Construct a histogram and frequency polygon for each of the four laboratory exercises. Use the information recorded on the Lab Record Sheets, and draw (and label) the histograms on the Homework Graph Sheets.

3. Use the histograms. Identify the type of frequency distribution in each case.

4. Use a calculator or Option 3 in the Introductory Statistics package. Compute the mean for each data set in the lab exercises. On each histogram draw a vertical line through the mean of the data.

5. Refer to the information for Lab Exercise 1.

   a) Do the data appear to be normally distributed? Explain why the weights of football players might have such a distribution.

   b) Use the cumulative percent column in the frequency table. Estimate the probability that the weight of a player is i) less than 230 lbs. ii) more than 249 lbs

   c) Is the mean of the distribution to the left or to the right of the mode? Explain why.

6. Use the information for Lab Exercise 2.

   a) Identify the type of distribution exhibited by the physics test scores. Does this seem unusual? Why?

   b) To assign letter grades of A, A-, A+ to the top 20% of the scores, what would be the lowest numerical score in the letter grade range? (Use the cumulative frequency column of your table.)

7. Use the information for Lab Exercise 3.

   a) Did you expect the frequency distribution for these data to be what it is? Why/why not?

   b) Use the frequency table. Give the probability of getting a telephone number whose last digit is even. Give the theoretical probability for getting such a number.

8. Use the information from Lab Exercise 4.

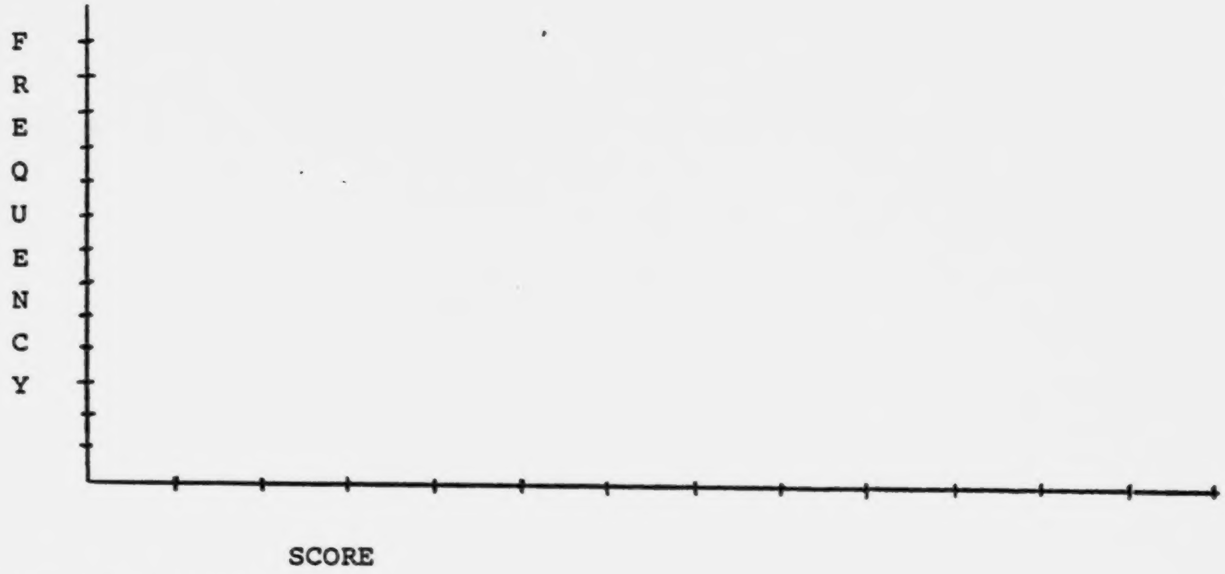
   a) The results of the readers' survey should have produced a bimodal distribution. Use your histogram. Give the two modes.

   b) What do the results of this survey suggest about the reading habits of American Statistician subscribers?

DISTRIBUTION SHAPES

HOMEWORK GRAPH SHEET

Histogram for Experiment #______

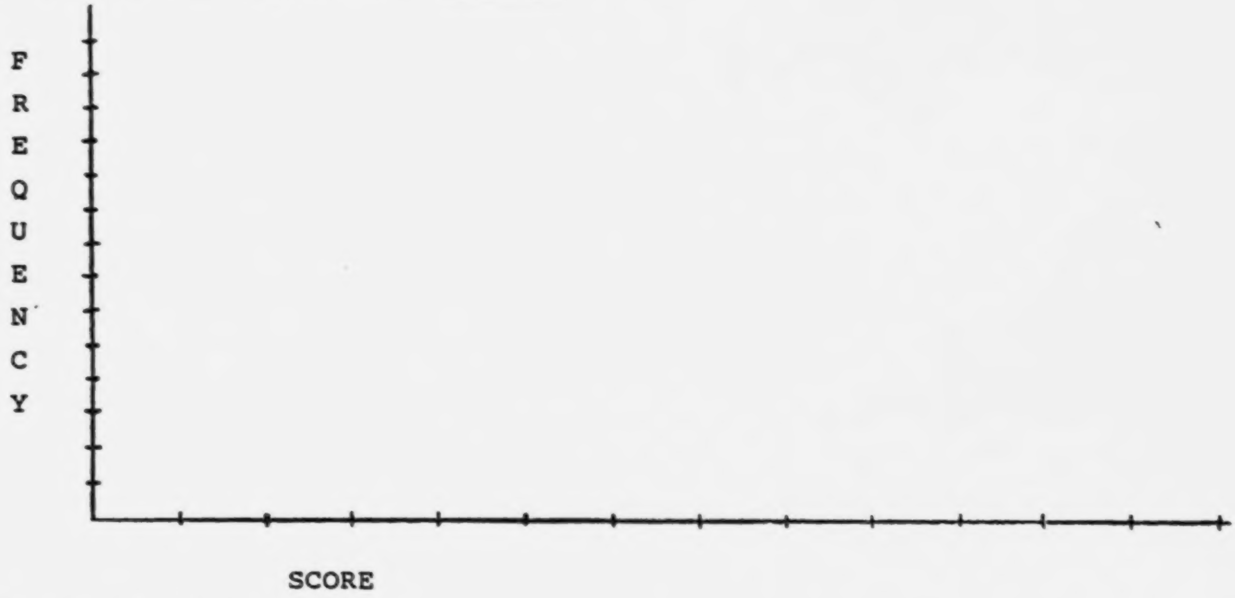


Type of Distribution________________________________

Mean score ($\bar{x}$)________________________________

HOMEWORK GRAPH SHEET

Histogram for Experiment #______



Type of Distribution________________________________

Mean score ($\bar{x}$)________________________________

DISTRIBUTION SHAPES
ANSWERS TO HOMEWORK EXERCISES

1. a) N b) R c) B d) U e) L

2. See following pages.

3,4. See following pages. If students saved their data sets as suggested, they can recall the data and use Mean and Standard Deviation (Menu item 3) to calculate the mean for each data set.

5. a) No. The distribution of the weights appears to be skewed left. The few lightweight football players on a team might be wide recievers, punters, or extra-point kickers. The majority of the players would fall in the heavy-weight group.

   b) i) 33.33% ii) 10%

   c) The mean (230.2) is to the left of the mode (234.5).

6. a) Normal distribution. This bell-shaped curve is a typical distribution for test scores.

   b) 70 would be the lowest score to earn A-.

7. a) If telephone numbers indeed are constructed and assigned randomly by the telephone company, then one would expect a uniform distribution of "last digits".

   b) (8+11+6+10+9)/100 = 0.44. Theoretically, the probability of an even "last digit" in a telephone number is 0.5.

8. a) The two modes are 0 and 12.

   b) This result indicates that the periodical either is read very little or it is read faithfully almost every month by subscribers.

DISTRIBUTION SHAPES

LAB RECORD SHEET

Data for Exercise # 1

Frequency Table

Interval#	Class Limits	Frequency	Cum.% (C%)
* 1	180 - 189	1	3.33
2	190 - 199	1	6.67
3	200 - 209	2	13.33
4	210 - 219	2	20
5	220 - 229	4	33.33
6	230 - 239	10	66.67
7	240 - 249	7	90
8	250 - 259	3	100
9			
10			
11			
12			

* Note: The program lists the intervals in reverse order (12-1). Be sure you record the data in the correct order.

LAB RECORD SHEET

Data for Exercise # 2

Frequency Table

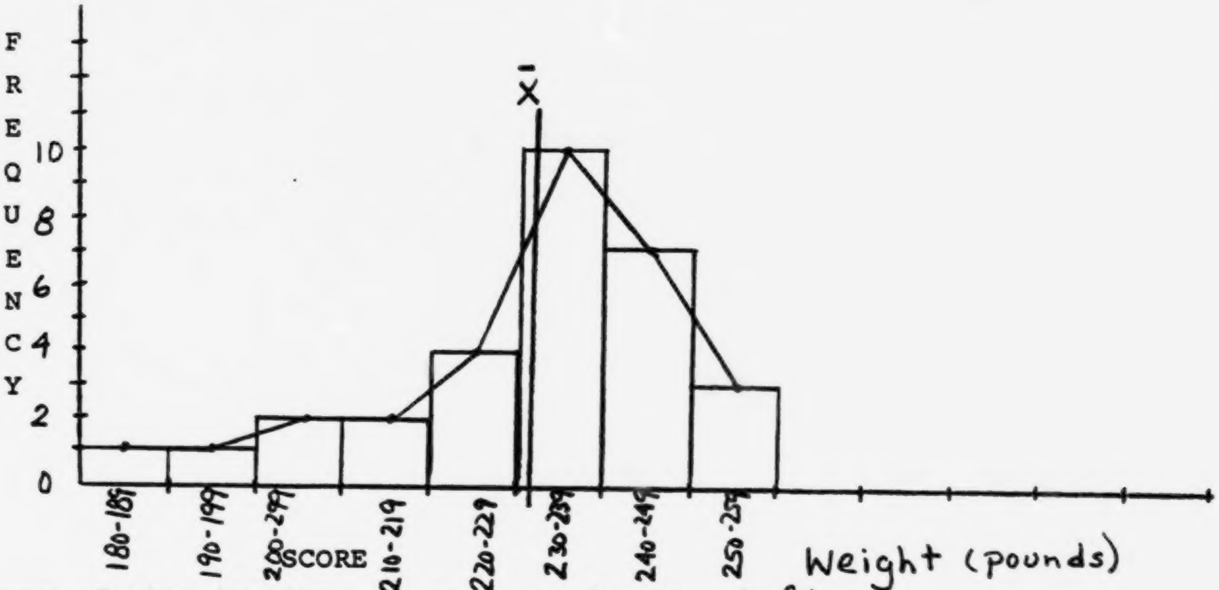
Interval#	Class Limits	Frequency	Cum.% (C%)
* 1	58-60	2	4
2	61-63	5	14
3	64-66	17	48
4	67-69	16	80
5	70-72	7	94
6	73-75	2	98
7	76-78	1	100
8			
9			
10			
11			
12			

* Note: The program lists the intervals in reverse order (12-1). Be sure you record the data in the correct order.

DISTRIBUTION SHAPES

HOMEWORK GRAPH SHEET

Histogram for Exercise #1

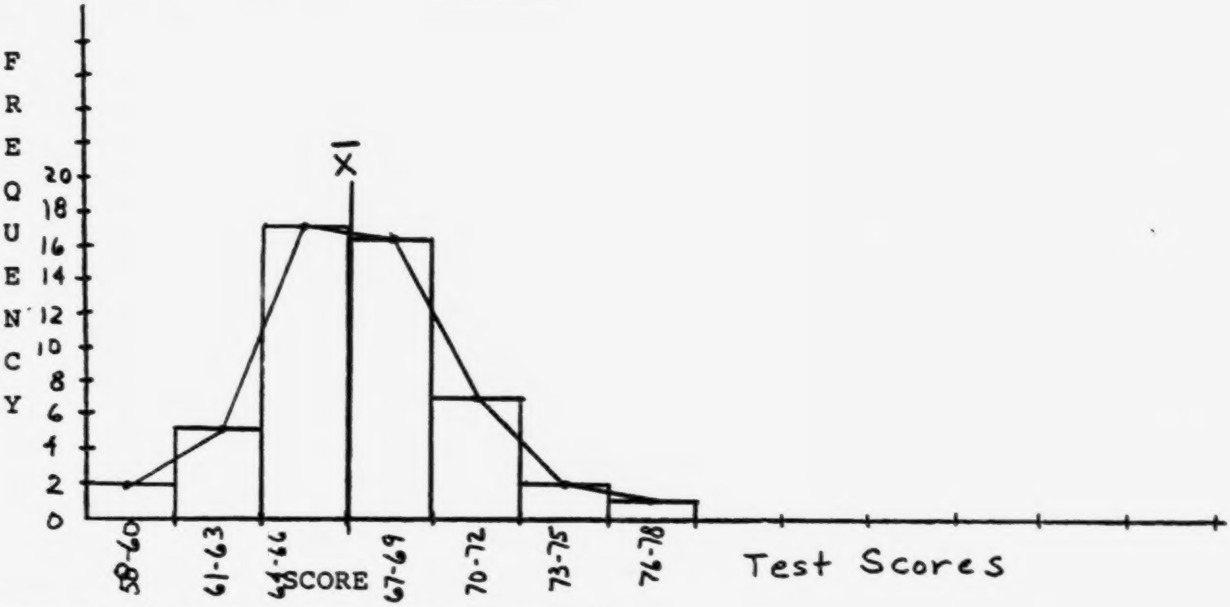


Type of Distribution skewed to the left

Mean score ($\bar{x}$) 230.2

HOMEWORK GRAPH SHEET

Histogram for Exercise #2



Type of Distribution Normal

Mean score ($\bar{x}$) 66.8

DISTRIBUTION SHAPES

LAB RECORD SHEET

Data for Exercise #3
Frequency Table

Interval#	Class Limits	Frequency	Cum.% (C%)
* 1	0-0	8	8
2	1-1	10	18
3	2-2	11	29
4	3-3	13	42
5	4-4	6	48
6	5-5	11	59
7	6-6	10	69
8	7-7	13	82
9	8-8	9	91
10	9-9	9	100
11			
12			

* Note: The program lists the intervals in reverse order (12-1). Be sure you record the data in the correct order.

LAB RECORD SHEET

Data for Exercise #4
Frequency Table

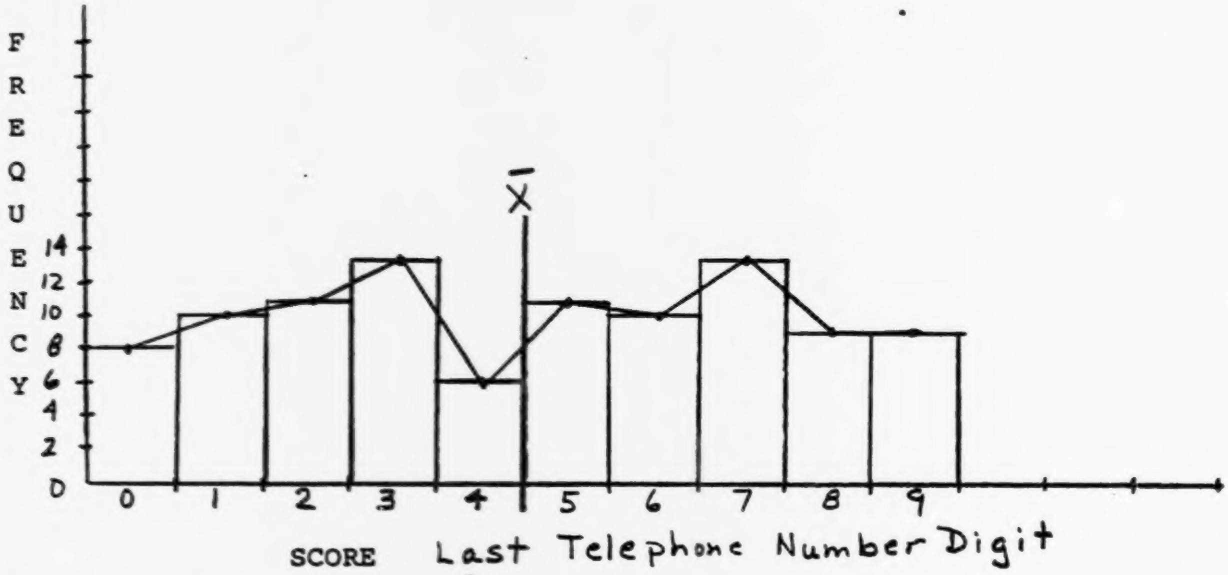
Interval#	Class Limits	Frequency	Cum.% (C%)
* 1	0-0	25	25
2	1-1	12	37
3	2-2	4	41
4	3-3	1	42
5	4-4	1	43
6	5-5	1	44
7	6-6	0	44
8	7-7	0	44
9	8-8	1	45
10	9-9	1	46
11	10-10	7	53
12	11-11	20	73
13	12-12	27	100

* Note: The program lists the intervals in reverse order (12-1). Be sure you record the data in the correct order.

DISTRIBUTION SHAPES

HOMEWORK GRAPH SHEET

Histogram for Exercise #3

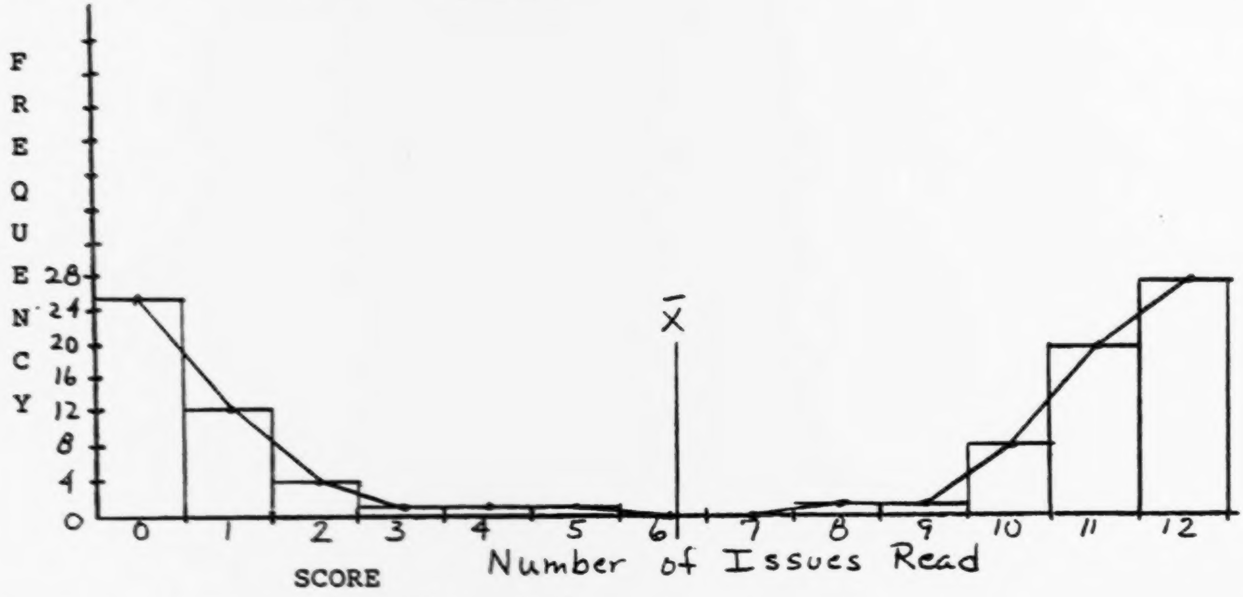


Type of Distribution Uniform

Mean score ($\bar{x}$) 4.5

HOMEWORK GRAPH SHEET

Histogram for Exercise #4



Type of Distribution Bimodal

Mean score ($\bar{x}$) 6.6

PIMMS 133 p.113d

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: SAMPLING FROM A POPULATION

OBJECTIVES:

to use a commercial program to calculate the mean and standard deviation for a given population

to compare sample means and standard deviations with those of the population

to determine the effect of sample size on estimating the population mean and standard deviation

COURSE: Statistics

SOFTWARE PACKAGE NEEDED: Introductory Statistics

SUGGESTED TIME:

one class period plus time for follow-up exercises

PREREQUISITE SKILLS/CONCEPTS:

familiarity with use of the software package

knowledge of the meaning of population mean and standard deviation _ and recognition of the sample variables s and x.

familiarity with using a table of random numbers

FORMAT: discovery/reinforcement lab

GENERAL DESCRIPTION OF THE LABORATORY ACTIVITY:

SAMPLING FROM A POPULATION
LABORATORY EXERCISES

DIRECTIONS:

Boot the Introductory Statistics disk. Select menu item 3, Mean and Standard Deviation. Be sure to read the program limitations carefully.

Data

The data for this laboratory activity consists of the SAT Math scores for 120 seniors in a central Connecticut high school who took the test (the population).

450	570	540	620	450	460	800	580	630	460	470	740	630	510	720	490	510	550	710	520
480	750	450	670	680	530	510	350	400	400	640	430	450	600	480	520	530	450	480	530
570	410	520	440	470	500	570	540	540	500	640	510	570	520	490	650	590	360	460	470
530	500	660	440	500	540	540	510	390	610	380	460	690	520	490	550	580	400	510	580
500	400	520	530	460	550	480	500	520	550	600	420	500	590	520	590	550	510	370	510
570	490	500	470	450	630	530	680	440	560	640	610	570	540	590	450	530	630	480	510

EXERCISE 1

Use the Introductory Statistics software to calculate the true mean and standard deviation for the population. [Mathematicians use the Greek letter mu (μ) to represent the population mean and sigma (σ) for the population standard deviation. Although the program uses $\bar{x}$ and s, which ordinarily represent the sample mean and standard deviation respectively, you have found the true population statistics by using all the data.] Record your values for mu and sigma:

μ = _____ , σ = _____.

EXERCISE 2

In this exercise you will learn how to use a table of random digits to help select a sample of 10 scores (at random, of couse) from the population.

First, draw a vertical line between the 10th and 11th columns of the table of SAT scores. This line divides the table into a left half and a right half each containing 60 scores. Next, label the ten columns in the left half of the table using the digits 0 - 9; do likewise for the ten columns in the right half. Now label the six rows of the table at their left and from top to bottom using the digits 0 - 5.

Now turn to the Table of Random Digits on the next page. To find the first SAT score for our sample set:

> Point at random to a place in the table, and read the digit. If that digit is even, take an SAT score from the left-hand portion of the data table; if odd, from the right-hand portion.
>
> Assume we get the digit 2. Use the left half. Continue to read across the table of random digits to the next digit, 0 - 9. We will use this digit to choose a column: If the digit is 7, we will use column 7 in the left side of the data table. Finally, continue to read across the TRD until you read a digit 0 - 5. This digit tells you the row to choose in the data table. Suppose the digit is 4: we will take the SAT score on the left, column 7, row 4 -- i.e., 500.

Encircle that score to indicate that it has been selected, and repeat the process until 10 scores have been RANDOMLY selected from the data. If by chance the process directs you to a location that already has been used, simply continue the process until you are directed to a different location. List here your 10 scores.

____ ____ ____ ____ ____ ____ ____ ____ ____ ____

Compute the **_sample** mean and standard deviation. [Mathematicians use x for the sample mean and s for the sample std. deviation.]

$\bar{x}$ = _____ , s = _____

EXERCISE 3

Start at a new place in the Table of Random Digits. Use the procedure for selecting random numbers given in Exercise 2. Choose a random sample of 30 test scores from the data table. List the scores here.

Compute the mean and std. deviation for your sample.

$\bar{x}$ = _____ , s = _____

EXERCISE 4

Choose a sample of 60 scores from the population by taking the first score (450) and then every other score as you proceed across each row in turn. Use the software to calculate the sample mean and sample standard deviation.

$\bar{x}$ = ______ , s = ______

SAMPLING FROM A POPULATION

Table One Thousand Random Digits

00	54463	22662	65905	70639	79365	67382	29085	69831	47058	08186
01	15389	85205	18850	39226	42249	90669	96325	23248	60933	26927
02	85941	40756	82414	02015	13858	78030	16269	65978	01385	15345
03	61149	69440	11286	88218	58925	03638	52862	62733	33451	77455
04	05219	81619	10651	67079	92511	59888	84502	72095	83463	75577
05	41417	98326	87719	92294	46614	50948	64886	20002	97365	30976
06	28357	94070	20652	35774	16249	75019	21145	05217	47286	76305
07	17783	00015	10806	83091	91530	36466	39981	62481	49177	75779
08	40950	84820	29881	85966	62800	70326	84740	62660	77379	90279
09	82995	64157	66164	41180	10089	41757	78258	96488	88629	37231
10	96754	17676	55659	44105	47361	34833	86679	23930	53249	27083
11	34357	88040	53364	71726	45690	66334	60332	22554	90600	71113
12	06318	37403	49927	57715	50423	67372	63116	48888	21505	80182
13	62111	52820	07243	79931	89292	84767	85693	73947	22278	11551
14	47534	09243	67879	00544	23410	12740	02540	54440	32949	13491
15	98614	75993	84460	62846	59844	14922	48730	73443	48167	34770
16	24856	03648	44898	09351	98795	18644	39765	71058	90368	44104
17	96887	12479	80621	66223	86085	78285	02432	53342	42846	94771
18	90801	21472	42815	77408	37390	76766	52615	32141	30268	18106
19	55165	77312	83666	36028	28420	70219	81369	41943	47366	41067

p.116a

SAMPLING FROM A POPULATION
HOMEWORK EXERCISES

1. Encircle the correct response.

   a) The population for Lab Exercise 1 is i) the 120 students who took the test ii) the 120 scores earned.

   b) The population mean and std. deviation are μ = _____, σ = _____.

2. a) For Lab Exercise 2, compare the 10-item sample mean test score with the true population mean. Find the percent error for the sample mean, $E_{s.m.}$.

$$\text{percent error}_{s.m.} = \frac{\text{sample mean} - \text{population mean}}{\text{population mean}} \times 100$$

$$E_{s.m._{10}} = \frac{\qquad}{\qquad} \times 100$$

$$=$$

   b) Find the percent error for the sample std. deviation.

$$\text{percent error}_{s.s.d.} = \frac{\text{sample s.d.} - \text{population s.d.}}{\text{population s.d.}} \times 100$$

$$E_{s.s.d._{10}} = \frac{\qquad}{\qquad} \times 100$$

$$=$$

3. a) Repeat Exercise 2 for the 30-item sample.

$$E_{s.m._{30}} = \frac{\qquad}{\qquad} \times 100$$

$$=$$

$$E_{s.s.d._{30}} = \frac{\qquad}{\qquad} \times 100$$

$$=$$

b) How does $E_{s.m._{30}}$ compare with $E_{s.m._{10}}$?
$E_{s.d._{30}}$ with $E_{s.d._{10}}$?

4. a) Repeat Exercise 2 for the 60-item sample.

$E_{s.m._{60}}$ = ------------------------ x 100

=

$E_{s.s.d._{60}}$ = ------------------------ x 100

=

b) How does $E_{s.m._{60}}$ compare with $E_{s.m._{10}}$?
$E_{s.d._{60}}$ with $E_{s.d._{10}}$?

5. Make a complete statement about population and sample means and standard deviations in terms of sample size.

6. The method used to choose the sample in Lab Exercise 4 is called **convenience sampling**. What might be wrong with choosing a sample via that method?

7. Based on your experience with this entire procedure, what number of scores do you think would constitute a reliable sample of the population?

Extra credit extension exercise:

8. Once all your classmates have completed the homework exercises to this point, record the class data for each calculated percent error. Then find the average percent error for each statistical variable for each sample size. Finally, based on this enlarged data base, give a reasonable sample size for estimating the population mean and s.d. Present your findings to the class.

SAMPLING FROM A POPULATION
ANSWERS TO HOMEWORK EXERCISES

1. a) ii b) $\mu = 529$, $\sigma = 85.1$

2., 3. Answers will vary.

4. a) (For 60 scores, $\bar{x} = 533.7$, $s = 86.4$)
   $E_{s.m.} = 0.89\%$ (less than 1%)
   $E_{s.s.d.} = 0.15\%$ (almost 0)

   b) Answers may vary.

5. The larger the sample size, the less the percentage error with respect to the population statistical variables.

6. The sample indeed might not be random. For example, if the scores had been listed by boy-girl-boy-girl, etc., the 60-score sample would contain boys' scores only or girls' scores only. For another example, the scores in each column might have come from a single homeroom -- whereby using only every-other score would eliminate scores in four other homerooms.

   Although in some cases convenience sampling may be the only practical method for choosing a sample, users of the technique must remain alert to possibilities for bias in the results.

7. Responses will vary in terms of the amount of error deemed tolerable and how well the computed values for the statistical variables agreed with the true values. Here, sample size 30 should give reliable results.

8. Answers will vary, but convergence of results should be expected as the size of the data base is increased.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: CORRELATION

OBJECTIVES:

to use a commercial program to calculate the coefficient of correlation between two variables

to use a commercially prepared program to determine an equation for the regression line (line of best fit) for the data

to explore the effect of altering the data on the coefficient of correlation

COURSE: Statistics

SOFTWARE PACKAGE NEEDED: Introductory Statistics

SUGGESTED TIME: one lab period plus
time for follow-up exercises

PREREQUISITE SKILLS/CONCEPTS:

familiarity with use of the software package

understanding of the formula for finding the coefficient of correlation, r

familiarity with meaning of regression line (least squares line)

ability to graph a straight line via the point-slope technique

FORMAT: discovery/reinforcement lab

GENERAL DESCRIPTION OF THE LABORATORY ACTIVITY

CORRELATION
LABORATORY EXERCISES

DIRECTIONS:

Boot the Introductory Statistics disk. Select the Correlation program (menu item 4). Be sure to read the program directions and limitations carefully.

EXERCISE 1

a) Use the program. Compute the correlation coefficient for the given data pairs.

x	y
2	5
4	7
5	4
7	9
8	10

r = _____

b) Use the program. Compute r for this set of paired data. [Note that each x-value in this set is 5 more than the corresponding value in the table in 1a.]

x	y
7	5
9	7
10	4
12	9
13	10

r = _____

c) Use the program. Compute r for this set of paired data. [Note that each x-value in this set is 5 times the corresponding value in the table in 1a.]

x	y
10	5
20	7
25	4
35	9
40	10

r = _____

EXERCISE 2

Use the program. Compute the correlation coefficient for the data pairs. Note that the value of one variable remains constant.

x	y
5	2
5	5
5	7
5	1
5	6

r = _____

[Record the message given by the program.]

EXERCISE 3

Return to the software package menu. Select Regression and Scatter Diagram (menu item 5). [It may take several seconds for the program to load.] Use for data the following SAT mean verbal and math scores for 12th graders who took the tests during the 1983-84 school year.

	Verbal	Math		Verbal	Math		Verbal	Math
Ala.	**466**	**508**	**Ky.**	**475**	**513**	**N. D.**	**505**	**560**
Alaska	**437**	**468**	**La.**	**469**	**502**	**Ohio**	**458**	**504**
Ariz.	**465**	**505**	**Maine**	**427**	**464**	**Okla.**	**489**	**521**
Ark.	**482**	**518**	**Md.**	**427**	**466**	**Ore.**	**432**	**469**
Calif.	**421**	**474**	**Mass.**	**427**	**463**	**Pa.**	**425**	**461**
Colo.	**469**	**520**	**Mich.**	**458**	**511**	**R.I.**	**422**	**459**
Conn.	**433**	**465**	**Minn.**	**482**	**538**	**S.C.**	**383**	**415**
Del.	**433**	**467**	**Miss.**	**474**	**507**	**S.D.**	**517**	**560**
Fla.	**423**	**464**	**Mo.**	**466**	**510**	**Tenn.**	**483**	**519**
Ga.	**390**	**428**	**Mont.**	**480**	**535**	**Texas**	**412**	**453**
Hawaii	**393**	**471**	**Neb.**	**494**	**546**	**Utah**	**508**	**545**
Idaho	**479**	**513**	**Nev.**	**441**	**480**	**Vt.**	**434**	**472**
Ill.	**462**	**517**	**N.H.**	**444**	**481**	**Va.**	**427**	**463**
Ind.	**410**	**454**	**N.J.**	**418**	**455**	**Wash.**	**463**	**510**
Iowa	**520**	**573**	**N.M.**	**484**	**519**	**W.Va.**	**466**	**512**
Kan.	**498**	**540**	**N.Y.**	**422**	**466**	**Wis.**	**473**	**533**
			N.C.	**394**	**431**	**Wyo.**	**492**	**530**

a) Enter the data (verbal score as x, math score as y). Check to be sure that you made no data entry errors. Compute the correlation coefficient. [Look. See the computer crunch numbers. See the pretty number-cruncher...] r = _______

b) Copy here the equation for the regression line given by the program.

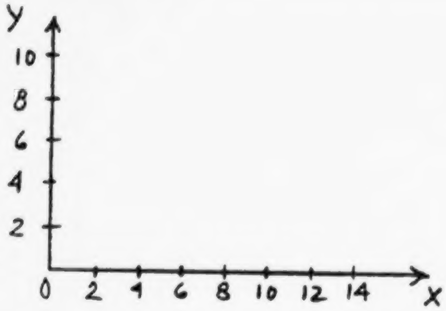
y = ______________________________

Ignore all other information subsequently given by or asked for by the program. It is beyond the scope of this high school course.

CORRELATION
HOMEWORK EXERCISES

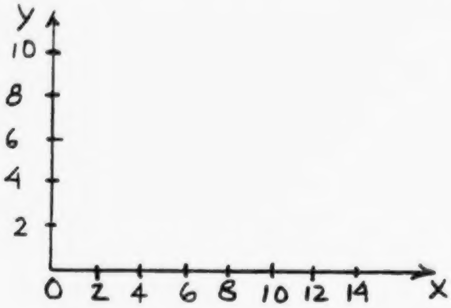
1. a) Use the axes given. Graph the data for Lab Exercise 1a Then decide whether there appears to be a strong or weak correlation between the set of x values and the set of y values. Copy r here.

r = ______



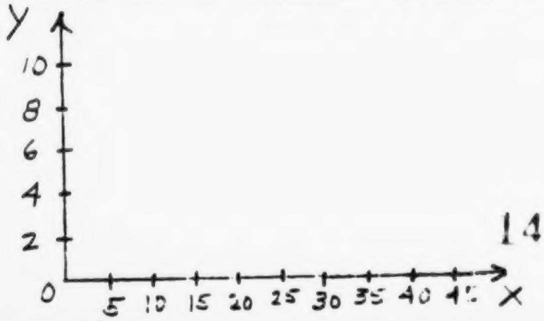
b) Use the axes given. Graph the data for Lab Exercise 1b Look at the graph -- does there seem to be a stronger, weaker, or unchanged correlation between x and y compared to that for data set 1a? What appears to be the effect on r of adding a constant to one element (here, the x-element) in each data pair? Copy r here.

r = ______



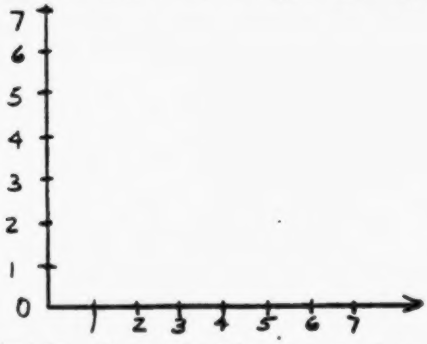
c) Use the axes given. Graph the data for Lab Exercise 1c Look at the graph -- does there seem to be a stronger, weaker, or unchanged correlation between x and y compared to that for data set 1a? What appears to be the effect on r of multiplying one element (here, the x-element) in each data pair? Copy r here.

r = ______



2. a) Refer to your records for Lab Exercise 2. How did the program respond when you attempted to compute the correlation coefficient for that data set?

b) Use the axes given. Draw a scatter plot (graph) of these data. What do you notice about the 5 points? Estimate the slope of the regression line.

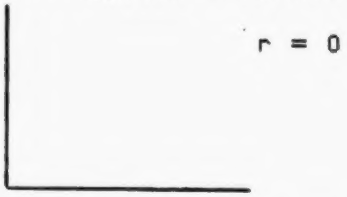


c) Write the statistical formula for calculating r. Which part of the formula causes the program difficulty?

3. Use the axes given.

a) Design a set of four data pairs (x,y) that will yield r = 0. Sketch a scatter plot for those data.

b) Design a set of four data pairs (x,y) that will yield r = 1. Sketch a scatter plot for those data.



4. a) Give the value of r produced by the program for the SAT scores. How strong is the correlation between the verbal and math scores?

b) Use the axes on the next page. Make a scatter plot of the data. [Use (200,200) for the origin. (Why?) Use scale interval 20 for each axis. Use the vertical scale (arbitrarily) for the verbal score and the horizontal scale for the math score.]

c) Draw the regression line on the scatter plot. [Plot the y-intercept. To find a second point in the line, choose, for example, x = 500 and compute the corresponding y-value via the program-generated equation.]

d) Use the regression line equation. Give the predicted math score for a student with verbal score 600. Is the score reasonable?

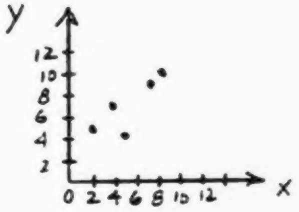
e) Give an explanation for the correlation between SAT verbal and math scores.

y
x

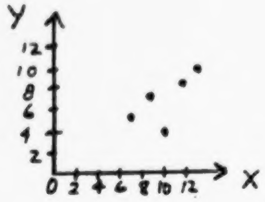
CORRELATION
ANSWERS TO HOMEWORK EXERCISES

1. a) ($r = 0.78$) moderately strong positive correlation
   b) ($r = 0.78$) Adding a constant to each x-value does not affect r.
   c) ($r = 0.78$) Multiplying each x-value by a constant doesn't affect r.

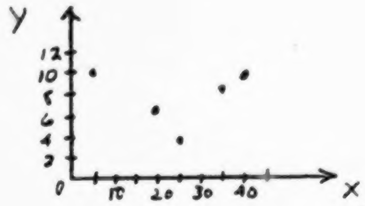
a)



b)



c)



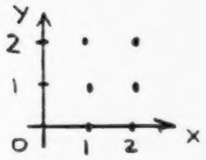
2. a) The program did not compute a value for r. Instead, the message, "SUM OF SQUARES = 0" was displayed.

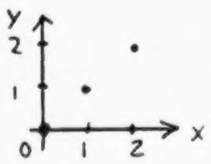
   b) The points are collinear in a vertical line; thus, the slope of the regression line   is undefined.

   c) $r = \dfrac{\overline{xy} - \overline{x} \cdot \overline{y}}{s_x \cdot s_y}$ Since s_x, the standard deviation of the y-values, equals 0, an "attempt to divide by zero" error occurs in the program and gives rise to the printed message.

3. a) Answers will vary.
   (1,1),(1,2),(2,1),(2,2)

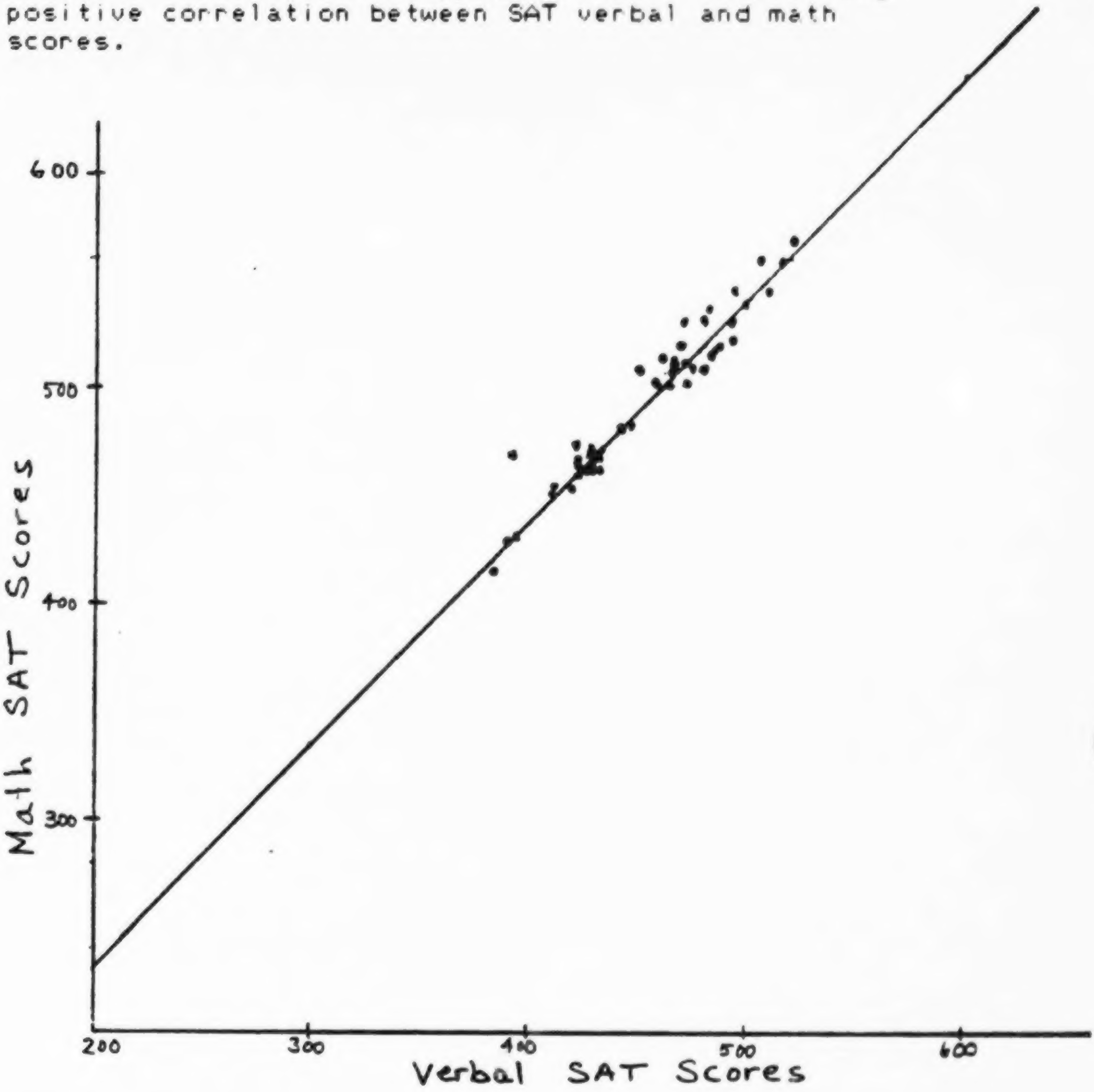
   b) Answers will vary.
   (0,0),(1,1),(2,2)





4. a) Since $r = 0.969$, there appears to be a very strong positive correlation between SAT verbal and math scores.

b)



c) The equation given for the regression line is

$y = 1.033x + 27.23$.

d) The predicted math score is 647. This value seems reasonable because of the high correlation coefficient and because in every case the math score is higher than the verbal score..

e) Answers will vary. However, the SAT is essentially a REASONING APTITUDE test and, although the particular symbols used may look different (math vs. English), reasoning ability is reasoning ability ...

TITLE: THE WHATSIT CORPORATION: SURVIVAL MATH SKILLS

PUBLISHER: Sunburst Communications, Inc.
39 Washington Ave.
Pleasantville, NY 10570

PRICE: $65.00
10-disk lab pack $195.00

COMPUTERS: Apple II, II+, IIc, IIe

PIMMS RATING: Very Good

PROGRAM IS APPROPRIATE FOR:

Course: General, Tech, Business, or Consumer Math
Algebra 1; 7th, 8th grade math

Ability level:

Middle school: average
High school: low/average

Format: Simulation

CHARACTERISTICS:
user-friendly,support material,
documentation, disk-dependent to save a
simulation

ADDITIONAL PERIPHERALS NEEDED: color monitor preferred

REVIEW AND DESCRIPTION:

This package consists of five lessons. The first four lessons are preparation for the fifth - RUNNING THE SIMULATION.

The Whatsit Corporation is a simulation program that allows the user to manage a one-product business for six simulated months. The user may conduct market surveys, buy franchises, hire salespersons or consultants, borrow money, set prices, manage inventory, buy advertising, and contend with the unpredictability of late shipments and supply shortages. The program stresses the importance of accurate record-keeping and attention to detail in the quest for higher profits. At the end of the six simulated months the program generates a final balance sheet.

The first three lessons should be presented in order (The Effect of Price on Sales, The Effect of Price on Income, The Effect of Advertising on Sales) since the objectives of one serve as prerequisites for the next. The fourth lesson (Sales Tax) has no prerequisite lesson. The program is menu-driven, easy to operate, and requires minimal keyboard skills. However, the program abounds with error traps that force the user to reconsider each decision before proceeding. (In fact, there are so many error-trapping routines that the need to confirm all of them can become tedious and frustrating.)

Although **The Whatsit Corporation** may be used by individual students, it is strongly advised that students work in teams of three or four. There are many opportunities for teams of students to cooperate in solving the problems and for competetion among teams.

Since the program involves multiple starting situations and a variety of random factors, it can be run repeatedly by the user without becoming repetitive. A "run" of a simulation can be saved for future use.

Although the running of the simulation can be done independently of the four preparatory lessons,it would be well to allow adequate time to prepare for it in order to take advantage of the mathematics involved. For students to fully appreciate the use of the mathematics to help solve their business problems it is extremely important to spend several lessons prior to the actual "run" in preparing them to respond thoughtfully and accurately to each situation as it arises.

Given the broad range of courses for which the program is appropriate, teachers should use their own judgement on the level of detail necessary. The package software manual provides background materials, transparency masters, and activity sheets, that may be used in conjunction with or instead of the materials provided in the lessons. Also, the use of electronic calculators can enhance the total learning situation.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: THE EFFECT OF PRICE ON SALES

OBJECTIVES:

to use a methematical model (formula) to predict the impact of price on sales

to reinforce understanding of the relationship among a formula, a table of its ordered pairs, and a line graph

SOFTWARE NEEDED: none

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

- evaluation of a simple one-variable formula
- drawing of a line graph from a table of ordered pairs
- ability to run the software program

GENERAL DESCRIPTION OF THE LAB ACTIVITY

The activity should begin with a brief intuitive discussion of the relationship between the price of a product (or service) and the demand for that product. For example, if the price of gasoline increases, what might you expect to happen to the sales of gasoline? If the price decreases, what would you expect to happen to sales?

In reality, economists can provide retailers with sales formulas to help predict sales expectations based on price. (For our purposes, these sales formulas always will be linear.)

Students (singly or in groups) should work through the lab activity sheets one at a time. Upon completion of a sheet, class discussion could be focused on summarizing information via the use of the chalkboard or overhead projector.

Encourage students to speculate about the line graphs -- particularly about the "ends" of the graph and the "steepness" of the lines. Encourage them to draw conclusions.

THE EFFECT OF PRICE ON SALES
LABORATORY EXERCISES

Usually the price of a product affects the demand for it. The product we are selling is called a **whatsit.** For the formulas in this lesson, P is the price per whatsit and N is the number of whatsits expected to be sold.

DIRECTIONS:

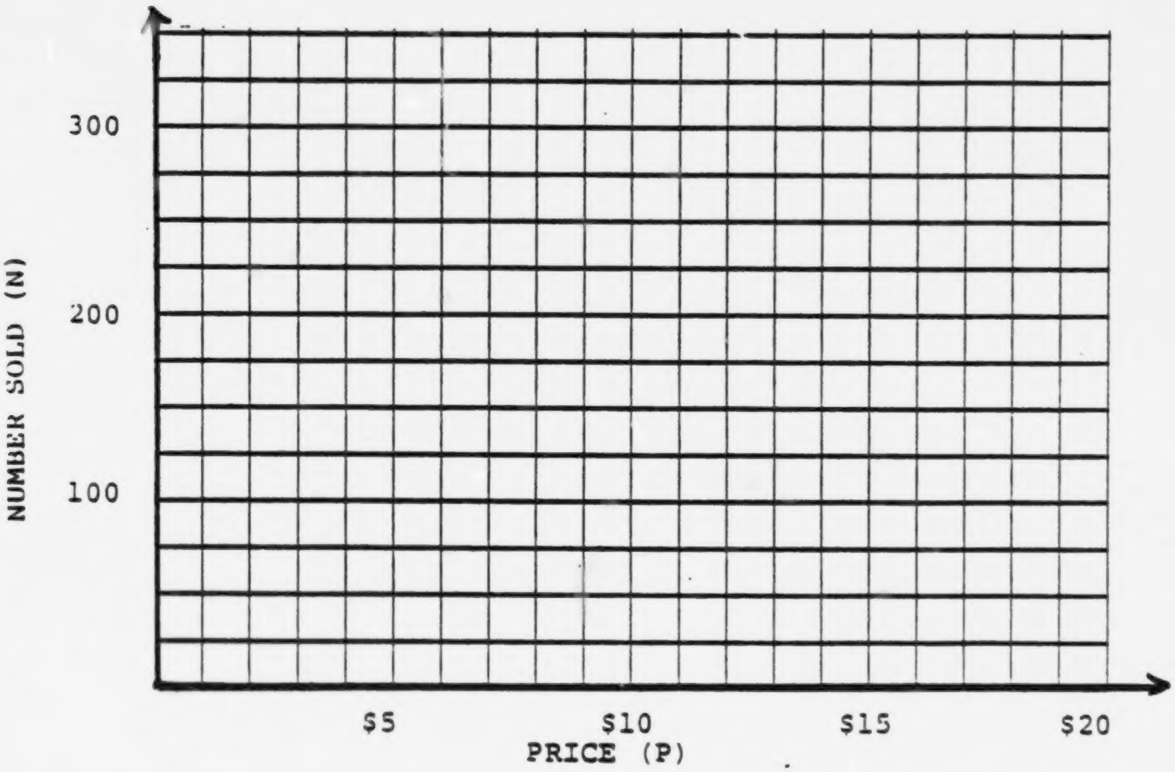
1. Use the sales formula $N = 400 - 20P$. Find the number of whatsits that the formula predicts will be sold at the given price.

   a) $5/whatsit b) $8/whatsit c) $10/whatsit

   d) $15/whatsit e) $20/whatsit

   f) When the price of a whatsit is more than $20, how many do you think will be sold?

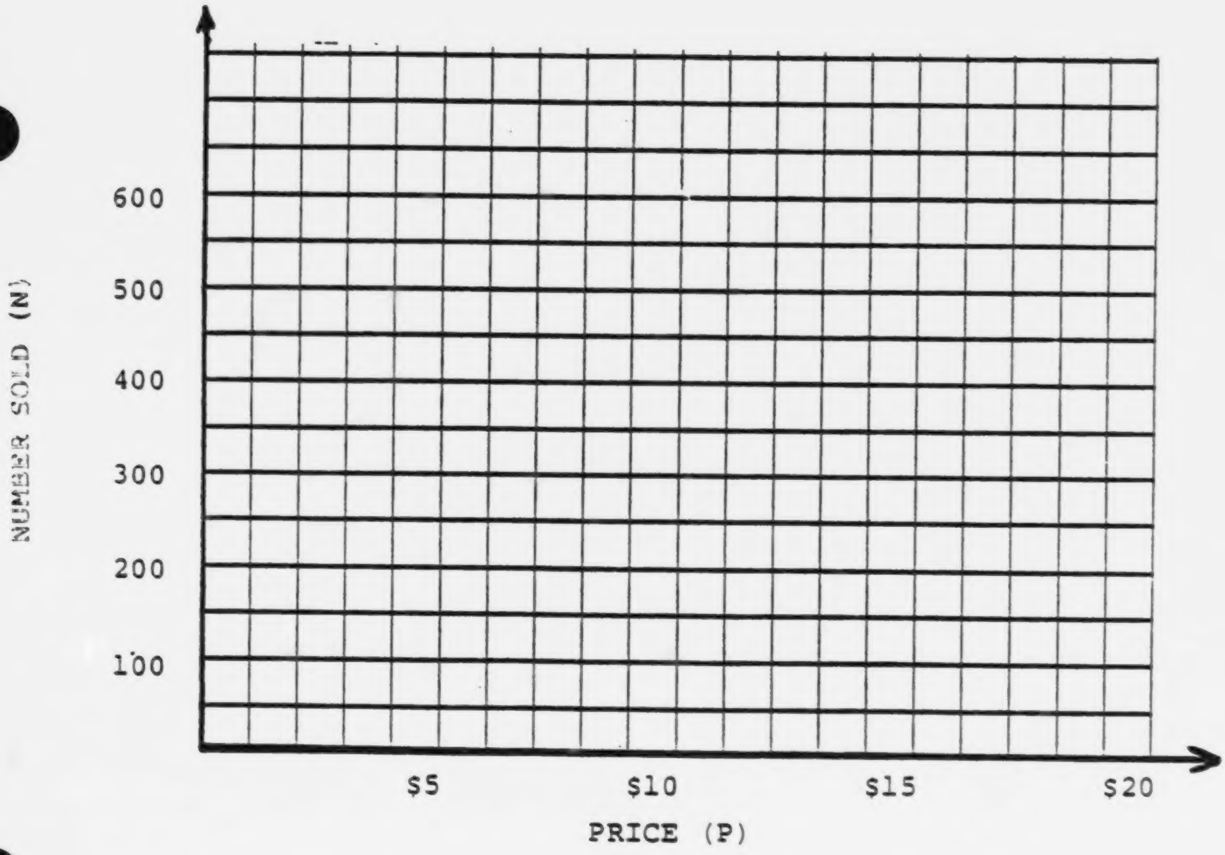
   g) Draw a line graph to show the number sold in relation to their price. Use the grid below and data a) - e).



2. Use the sales formula $N = 800 - 50P$. Find the number of whatsits that the formula predicts will be sold at the given price.

	P	N
a)	\$5	________
b)	\$7	________
c)	\$8	________
d)	\$10	________
e)	\$14	________
f)	\$16	________

g. Draw a line graph to show the number sold in relation to their price. Use the grid below and data a) - f).



In some months or seasons certain products sell better than at other times. For example, ice cream sells better in June than in January...

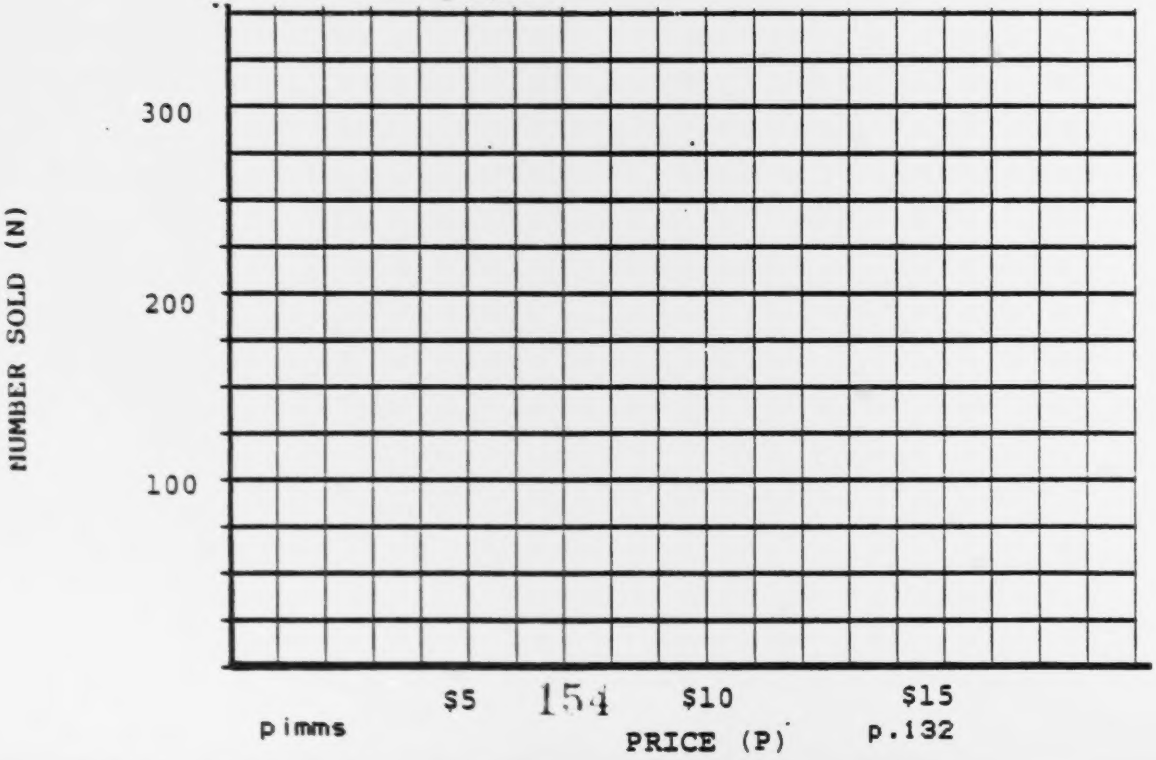
The market for our product will be rated "good", "moderate", or "poor" each month based on how easily whatsits can be sold in that month. The predictor formulas are:

good	$N = 500 - 20P$
moderate	$N = 500 - 22P$
poor	$N = 500 - 24P$

3. a) Use the predictor formulas. Find the number of whatsits that you can expect to sell in each type of market at the given price.

			Market	
		Good	Moderate	Poor
Price	$8.00	____	____	____
	$10.00	____	____	____
	$12.00	____	____	____
	$15.00	____	____	____

b) Draw a line graph to show the number expected to be sold in relation to price for each type of market. Identify each graph.

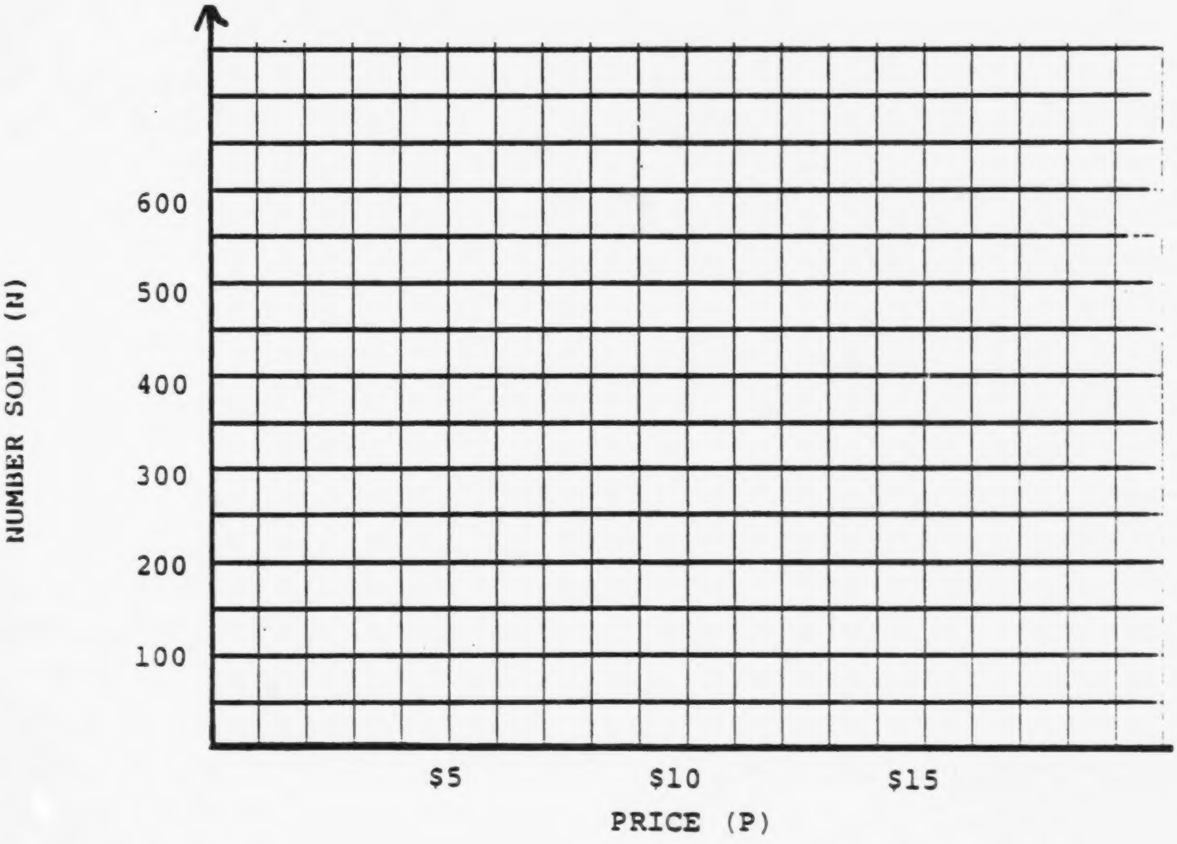


4. a) Use the given predictor formulas. Find the number of whatsits that you can expect to sell in each type of market at the given price.

good	N = 600 - 30P
moderate	N = 600 - 33P
poor	N = 600 - 36P

		Market		
		Good	Moderate	Poor
Price	$5.00	____	____	____
	$8.00	____	____	____
	$10.00	____	____	____
	$13.00	____	____	____

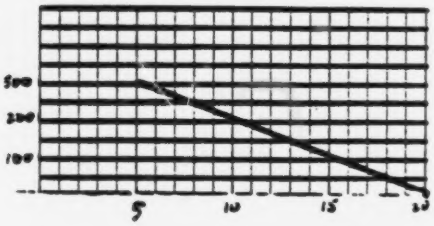
b) Draw a line graph to show the number expected to be sold in relation to price for each type of market. Identify each graph.



THE EFFECT OF PRICE ON SALES
ANSWERS TO LABORATORY EXERCISES

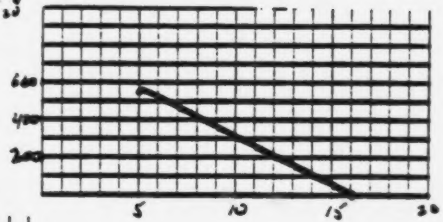
1. a)300
   b)240
   c)200
   d)100
   e)0
   f)0

1g)



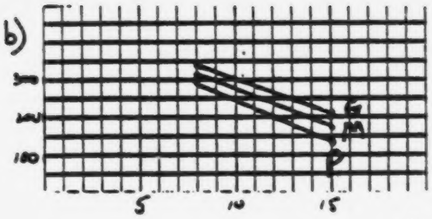
2. a) 550
   b) 450
   c) 400
   d) 300
   e) 100
   f) 0

2g)



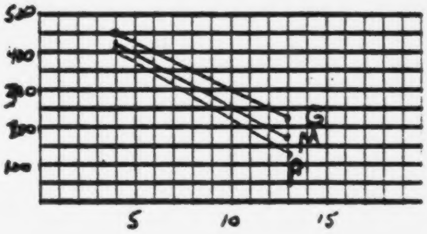
3. a)	340	324	308
	300	280	260
	260	236	212
	200	170	140

b)



4. a)	450	435	420
	360	336	312
	300	270	240
	210	171	132

b)



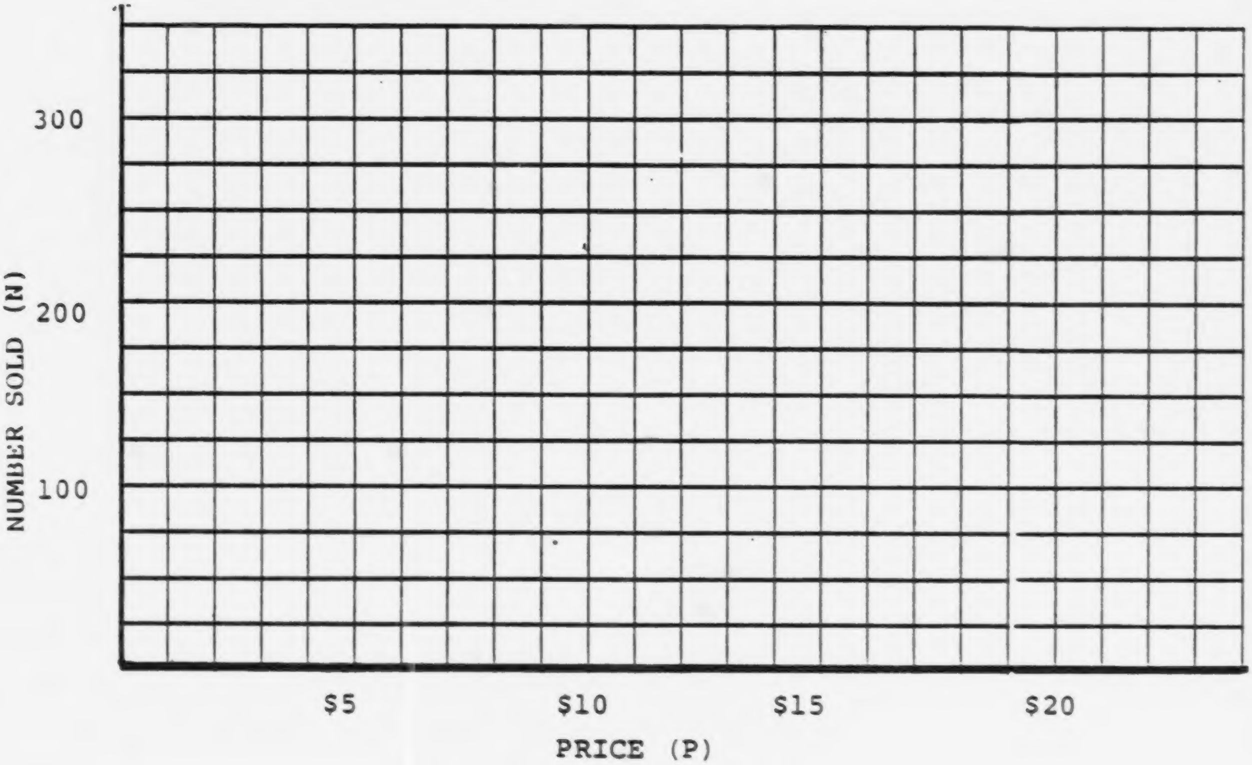
THE EFFECT OF PRICE ON SALES
HOMEWORK EXERCISES

1. Use the whatsit sales formula $N = 450 - 20P$ where N is the number of whatsits expected to be sold and P is the price per whatsit. Find the number of whatsits expected to be sold at the given price.

   a) $8　　b) $12　　c) $15　　d)$20

   e) Draw a line graph to show the number expected to be sold in relation to the price.

   f) Use your graph. Give the price at which you would expect to sell no whatsits.

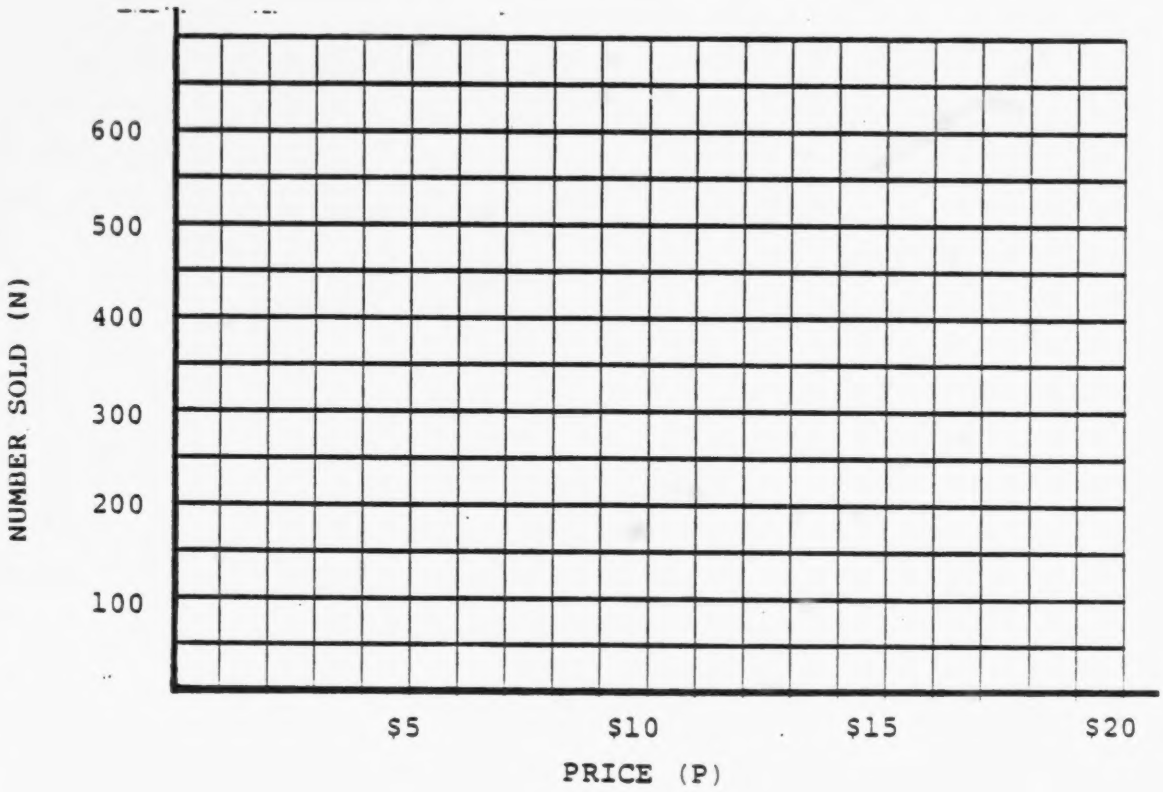


2. a) Use the predictor formulas. Find the number of whatsits that you can expect to sell in each type of market at the given price.

good	$N = 500 - 15P$
moderate	$N = 500 - 20P$
poor	$N = 500 - 25P$

			MARKET	
		Good	Moderate	Poor
PRICE	$5	______	______	______
	$10	______	______	______
	$15	______	______	______
	$20	______	______	______

b) Use the grid below. Draw a line graph to show the number expected to be sold in relation to price for each type of market. Identify each graph.



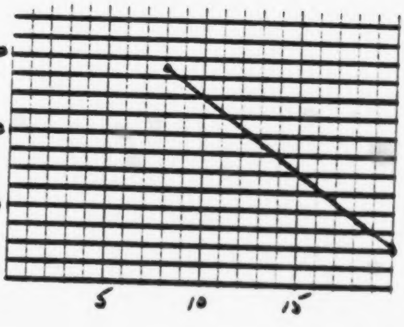
THE EFFECT OF PRICE ON SALES
ANSWERS TO HOMEWORK EXERCISES

1. a) 290
   b) 210
   c) 150
   d) 50
   f) about $22.50

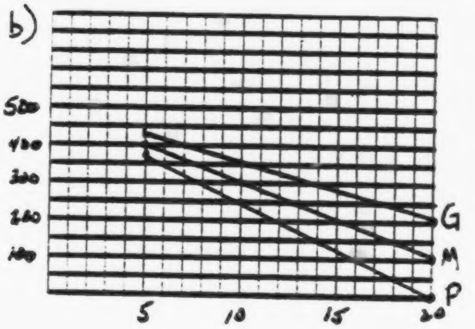
2. a)

425	400	375
350	300	250
275	200	125
200	100	0

e)



b)



COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: THE EFFECT OF PRICE ON INCOME

OBJECTIVES:

to use a mathematical model (formula) to predict the effect of price on income

to use a mathematical model to predict the best price to charge for a product

COURSES:

General, Tech, Business, Consumer, Career Math
7th and 8th grade math

SOFTWARE PACKAGE NEEDED: none

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

evaluation of a simple one-variable formula
drawing of a simple smoothed line graph

GENERAL DESCRIPTION OF THE LAB ACTIVITY

This activity should follow THE RELATIONSHIP BETWEEN PRICE AND SALES and be presented in similar fashion.

Pose the situation: A whatsit sales formula is N = 400 - 20P and the question: How many whatsits would you expect to sell when the price is $0, $5, $10, $15, or $20 ? (Ans.400,300,200,100,0)

Next, recall with students that Income = Price x Number Sold (I = PN). Have them find the income to be earned by the sales at each of the prices. (Ans. P=0,I=0; P=5,I=1500; P=10,I=2000; P=20,I=0)

Show this relationship via a table and via a graph of Price vs. Income.

Ask what price gives the largest income. Might there be a better price? (Try some.) Draw conclusions if possible. Point out that the highest price does not maximize income; neither does selling as many whatsits as possible.....

Note that Ex. 21 requires the student to speculate about a process for determining the "best" price for maximizing income. Have the class discuss this and draw conclusions.

Proceed to the Laboratory Exercises.

THE EFFECT OF PRICE ON INCOME
LABORATORY EXERCISES

Selling a large number of whatsits may be good, but more important to our company is maximizing income. (Selling 500 whatsits at $2 each produces less income than selling 200 whatsits at $8 each.)

To determine our income we multiply the number of whatsits sold by the price per whatsit (I = NP). For example,

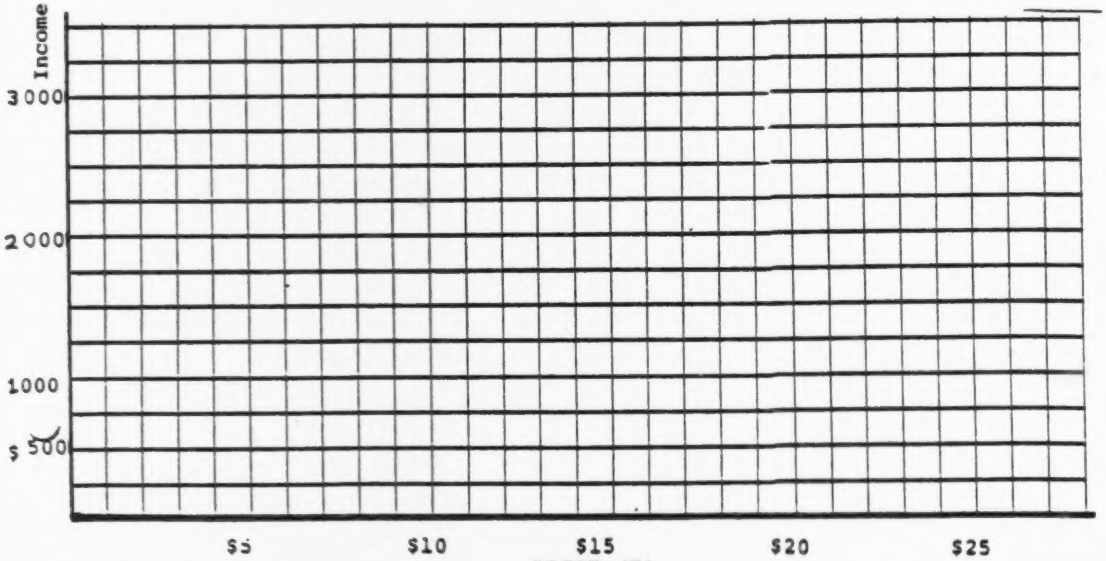
$$I = NP$$
$$I = 500 \text{ whatsits} \times \$2/\text{whatsit}$$
$$I = \$1000$$

EXERCISES

1. Use the sales formula N = 500 -20P. Find the number of whatsits expected to be sold at the given price. Then find the income by using the formula I = NP.

	Price (P)	Number expected to be sold (N)	Income (I)
a)	$5		
b)	$8		
c)	$10		
d)	$12		
e)	$15		
f)	$20		
g)	$25		

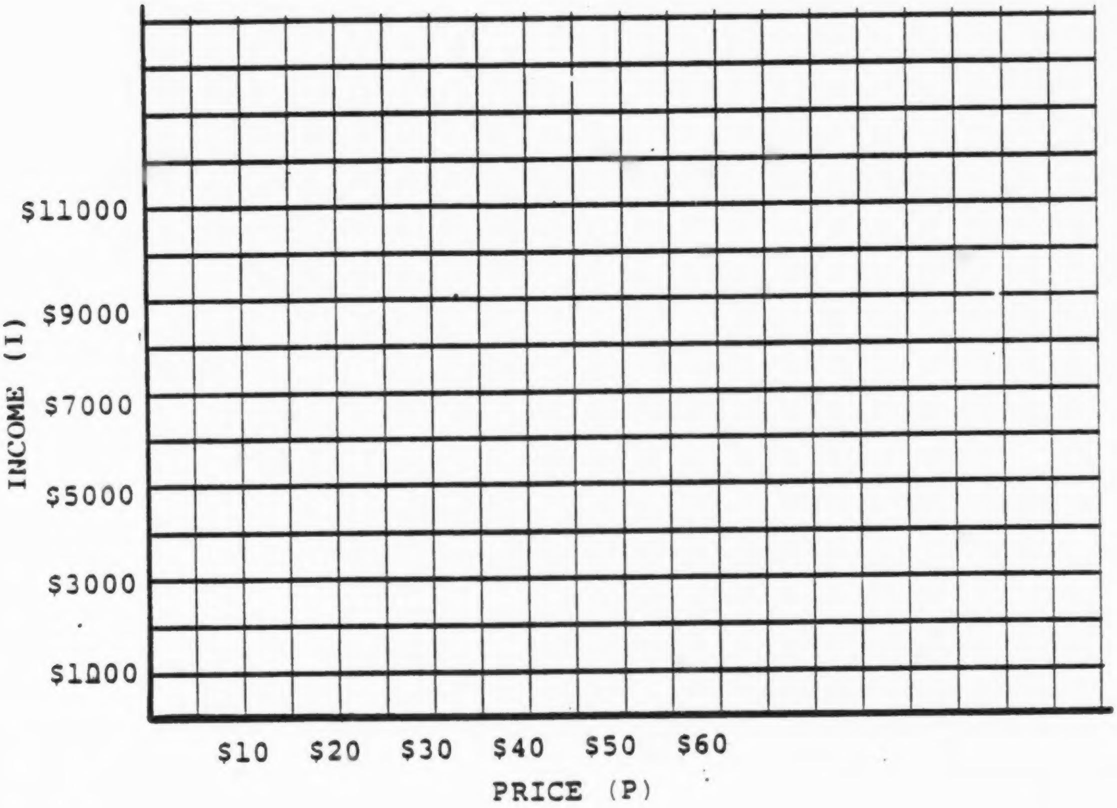
h) Use the grid.Graph the relationship of income to price



2. Use the sales formula N = 640 - 10P. Find the income for the given price.

	Price (P)	Number sold (N)	Income (I)
a)	$10		
b)	$20		
c)	$30		
d)	$40		
e)	$50		
f)	$60		

g) Use the grid. Graph the relationship of income to price.

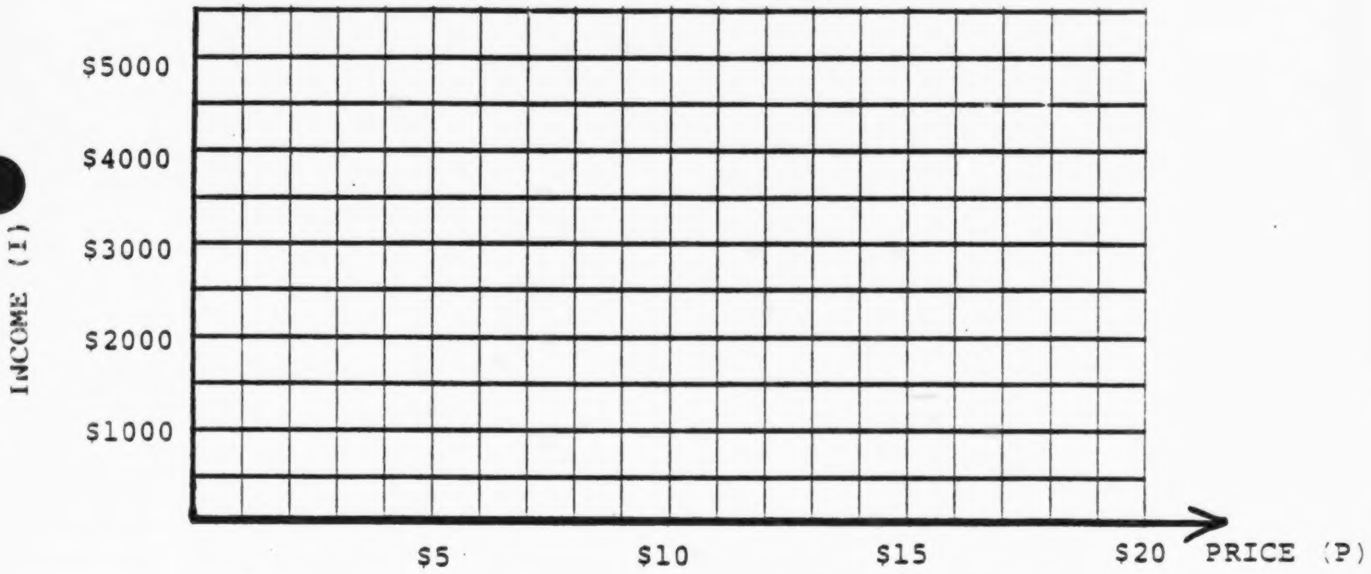


3. Use the sales formulas given below. For each price find the number of whatsits expected to be sold and the expected income.

good $N = 600 - 20P$
moderate $N = 600 - 25P$
poor $N = 600 - 30P$

PRICE	MARKET CONDITION					
	Good		Moderate		Poor	
a) $5	N=	I=	N=	I=	N=	I=
b) $8	N=	I=	N=	I=	N=	I=
c) $10	N=	I=	N=	I=	N=	I=
d) $15	N=	I=	N=	I=	N=	I=
e) $20	N=	I=	N=	I=	N=	I=

f) Draw three smooth graphs to show the relationship of income to price. Identify each graph.



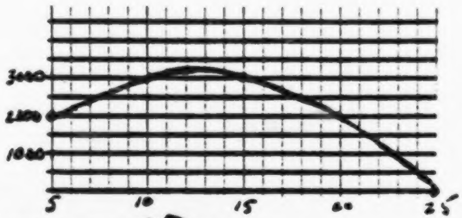
g) What price will maximize the income in a good market?
in a moderate market?
in a poor market?

4. Use your answers to the previous exercises. Tell how to predict the maximum income based on price.

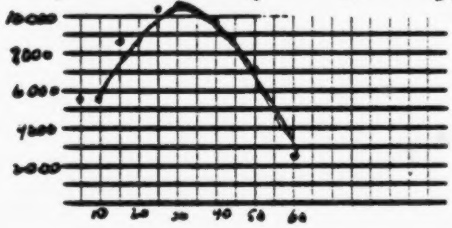
THE EFFECT OF PRICE ON INCOME
ANSWERS TO LABORATORY EXERCISES

1. a) N = 400 I = $2000
   b) N = 340 I = $2720
   c) N = 300 I = $3000
   d) N = 260 I = $3120
   e) N = 200 I = $3000
   f) N = 100 I = $2000
   g) N = 0 I = $0

h)



g)

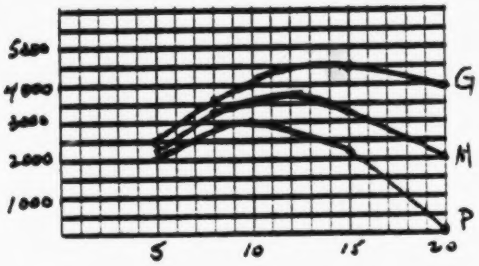


2. a) N = 540 I = $5400
   b) N = 440 I = $8800
   c) N = 340 I = $10200
   d) N = 240 I = $9600
   e) N = 140 I = $7000
   f) N = 40 I = $2400

3.

	GOOD		MODERATE		POOR	
a)	N = 500	I = $2500	N = 475	I = $2375	N = 450	I = $2250
b)	N = 440	I = $3520	N = 400	I = $3200	N = 360	I = $2880
c)	N = 400	I = $4000	N = 350	I = $3500	N = 300	I = $3000
d)	N = 300	I = $4500	N = 225	I = $3375	N = 150	I = $2250
e)	N = 200	I = $4000	N = 100	I = $2000	N = 0	I = $0

f)



g) about $15
about $10
about $10

4. Answers may vary. One technique would be to find the non-zero value for Price (P) that gives zero for Income (I); the maximum income then is given by 1/2 P.

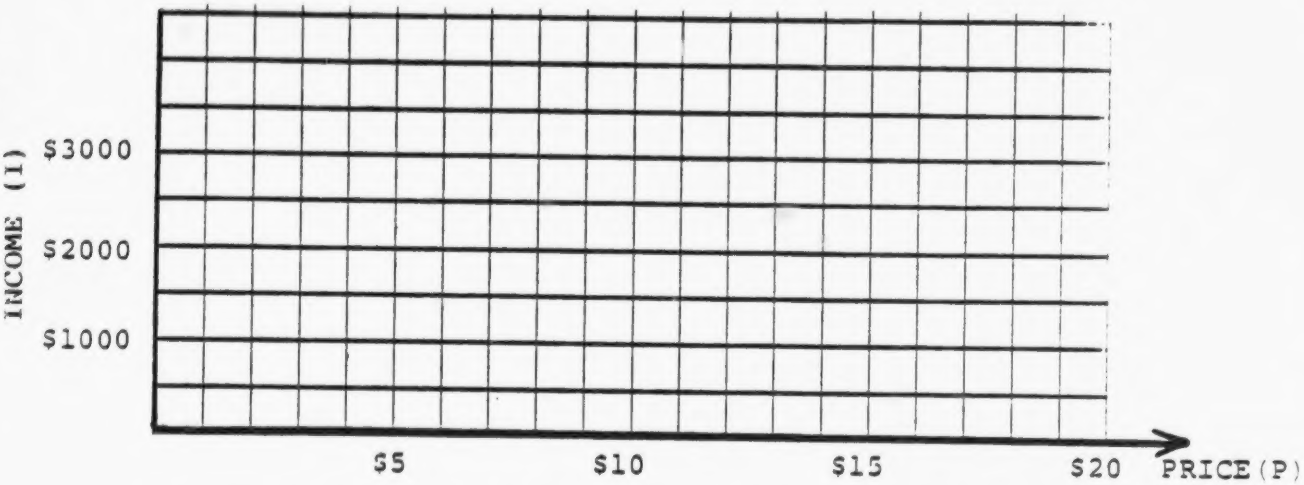
THE EFFECT OF PRICE ON INCOME
HOMEWORK EXERCISES

1. Use the sales formulas given below. For each price, find the number of whatsits expected to be sold and the expected income.

good $N = 300 - 10P$
moderate $N = 300 - 15P$
poor $N = 300 - 20P$

PRICE	MARKET CONDITION					
	Good		Moderate		Poor	
a) $4	N=	I=	N=	I=	N=	I=
b) $8	N=	I=	N=	I=	N=	I=
c) $12	N=	I=	N=	I=	N=	I=
d) $15	N=	I=	N=	I=	N=	I=
e) $18	N=	I=	N=	I=	N=	I=

f) Draw three smooth graphs to show the relationship of income to price. Identify each graph.



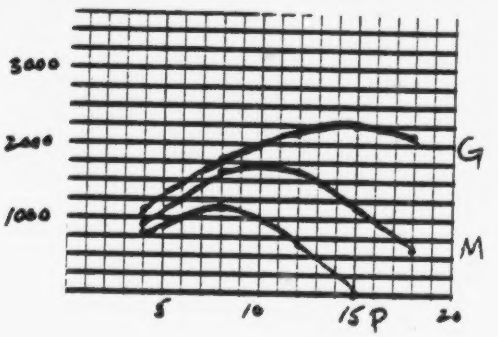
g) What price will maximize the income in a good market?
in a moderate market?
in a poor market?

THE EFFECT OF PRICE ON INCOME
ANSWERS TO HOMEWORK EXERCISES

	GOOD		MODERATE		POOR	
1. a)	N = 260	I = $1040	N = 240	I = $960	N = 220	I = $880
b)	N = 220	I = $1760	N = 180	I = $1440	N = 140	I = $1120
c)	N = 180	I = $2160	N = 120	I = $1440	N = 60	I = $720
d)	N = 150	I = $2250	N = 75	I = $1125	N = 0	I = $0
e)	N = 120	I = $2160	N = 30	I = $540		

g) about $15
about $10
about $8

f)



COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: THE EFFECT OF ADVERTISING ON SALES

OBJECTIVES:

to make adjustments to a mathematical model (formula) and note changes in the outcomes

to determine whether an advertising campaign is successful

COURSES: General, Tech, Business, Consumer, Career Math
7th and 8th grade math

SOFTWARE PACKAGE NEEDED: none

SUGGESTED TIME: one class period

PREREQUISITE SKILLS/CONCEPTS:

evaluate simple one-variable formulas

compute a percent of a number

GENERAL DESCRIPTION OF THE LAB ACTIVITY

This activity may be introduced with a brief discussion of advertising in its many forms. Make a list of the different ways one might advertise a product and roughly rank them from a) most expensive to least expensive, and b) those that reach the largest audience to those that reach the smallest. Such lists should have a great deal in common.

The simulation program (Lesson 5) will restrict the user to three types of advertising campaigns. The most expensive campaigns will create the greatest gains in the potential market for whatsits. Under the program, students will determine whether commissioning an advertising campaign is a wise use of capital, and, if so, which type of campaign is best.

To help assure that students understand the procedure, work through the first page of the activity sheet as a group activity, then have the students complete the sheets individually. Also check results as a group activity.

THE EFFECT OF ADVERTISING ON SALES
LABORATORY EXERCISES

In the sales formula N = 400 - 15P the number 400 represents the potential market for whatsits. That is, if we choose to give away whatsits, 400 whatsits would be "sold" [P=0, N = 400 - (15)(0) = 400]. Thus, 400 is the largest number of whatsits we can hope to sell -- even by giving them away.

When we advertise our product via newspapers, television, or billboards, we expect our potential market to increase significantly -- that is, by a significant percent of our previous potential market.

EXERCISES:

1. Let's assume that under the sales formula given above an advertising campaign increases our potential market by 12%.

   a) How large is the new potential market? ____________
      (Hint: 12% of 400 represents the increase.)

   b) Give the new sales formula. ________________________

2. Now assume that the price of our whatsit is $10.

   a) How many whatsits would be sold under the original sales formula (N = 400 - 15P)? ___________

   b) Find the income. (Remember -- Income equals Sales times Price, or, I = NP) ________________

   c) How many whatsits would be sold under the new sales formula? (Use the formula you gave in response to 1b.)

   d) What would be the new income? ____________

3. Assume that the advertising campaign costs $300. Do you think this is a worthwhile expense? _______ Why?

4. Use the givens -- the sales formula, the percent increase in the potential market, the price per whatsit, the cost of the advertising campaign; determine whether the owner will make or lose money by buying the advertising.

a) Sales formula: $N = 500 - 20P$
Advertising will increase sales by 7%.
Cost of advertising is $300.
Price per whatsit is $12.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

b) Sales formula: $N = 600 - 35P$
Advertising will increase sales by 9%.
Cost of advertising is $700.
Price per whatsit is $15.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

c) Sales formula: N = 450 - 20P
Advertising will increase sales by 12%.
Cost of advertising is $700.
Price per whatsit is $12.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

d) Sales formula: N = 360 - 12P
Advertising will increase sales by 5%.
Cost of advertising is $200.
Price per whatsit is $9.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

e) Sales formula: N = 550 - 18P
Advertising will increase sales by 8%.
Cost of advertising is $500.
Price per whatsit is $16.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

THE EFFECT OF ADVERTISING ON SALES
ANSWERS TO LABORATORY EXERCISES

1. a) 448
b) N = 448 - 15P
2. a) 250
b) $2500
c) 298
d) $2980
3. Yes! Sales increased $480.

4. a) 535
N = 535 - 20P
260
$3120
295
$3540
Yes! Sales increased $420.

b) 654
N = 654 - 35P
75
$1125
129
$1935
Yes! Sales increased $810.

c) 504
N = 504 - 20P
210
$2520
264
$3168
No! Sales only increased $648.

d) 378
N = 378 - 12P
252
$2268
270
$2430
No! Sales only increased $162.

e) 594
N = 594 - 18P
262
$4192
306
$4896
Yes! Sales increased $704.

THE EFFECT OF ADVERTISING ON SALES
HOMEWORK EXERCISES

Use the givens -- the sales formula, the percent increase in the potential market, the price per whatsit, the cost of the advertising campaign; determine whether the owner will make or lose money by buying the advertising.

1. a) Sales formula: $N = 610 - 22P$
   Advertising will increase sales by 10%.
   Cost of advertising is $800.
   Price per whatsit is $18.

   How large is the new potential market?

   Give the new sales formula.

   How many whatsits can be sold under the original sales formula?

   What will be the income under the original sales formula?

   How many whatsits can be sold under the new sales formula?

   What will be the income under the new sales formula?

   Will the owner make more money via the advertising?

   b) Sales formula: $N = 260 - 12P$
   Advertising will increase sales by 10%.
   Cost of advertising is $250.
   Price per whatsit is $8.

   How large is the new potential market?

   Give the new sales formula.

   How many whatsits can be sold under the original sales formula?

   What will be the income under the original sales formula?

   How many whatsits can be sold under the new sales formula?

   What will be the income under the new sales formula?

   Will the owner make more money via the advertising?

c) Sales formula: N = 460 - 27P
Advertising will increase sales by 10%.
Cost of advertising is $300.
Price per whatsit is $11.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

d) Sales formula: N = 640 - 22P
Advertising will increase sales by 15%.
Cost of advertising is $1000.
Price per whatsit is $14.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

e) Sales formula: N = 800 - 46P
Advertising will increase sales by 15%.
Cost of advertising is $1000.
Price per whatsit is $10.

How large is the new potential market?

Give the new sales formula.

How many whatsits can be sold under the original sales formula?

What will be the income under the original sales formula?

How many whatsits can be sold under the new sales formula?

What will be the income under the new sales formula?

Will the owner make more money via the advertising?

THE EFFECT OF ADVERTISING ON SALES
ANSWERS TO HOMEWORK EXERCISES

1.a) 671
N = 671 - 22P
214
$3852
275
$4950
Yes! Sales increased $1098.

b) 286
N = 286 - 12P
164
$1312
190
$1520
No! Sales only increased $208.

c) 506
N = 506 - 27P
209
$2299
255
$2805
Yes! Sales increased $506.

d) 736
N = 736 - 22P
332
$4648
428
$5992
Yes! Sales increased $1344.

e) 920
N = 920 - 46P
340
$3400
460
$4600
Yes! Sales increased $1200.

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: SALES TAX

OBJECTIVE:

to determine the amount of quarterly sales tax a company must pay to the state government

COURSES: General, Business, Consumer, Career Math
7th and 8th grade math

SOFTWARE NEEDED: none.

SUGGESTED TIME: one-half class period

PREREQUISITE SKILLS/CONCEPTS:

compute a percent of a number

GENERAL DESCRIPTION OF THE LAB ACTIVITY

This brief activity should require about 20 minutes and might be used in conjunction with a quiz or review.

A discussion of the role of a sales tax and the role of retailers as tax collection agents for the state government might be enlightening for many students. Talk with students about how a company might maintain cumulative records of taxes collected, and, more importantly, how the state might authenticate those records.

Work through the first few exercises on the worksheet as a group activity, then have the students individually complete the remaining exercises.

SALES TAX
LABORATORY EXERCISES

As a retailer (of whatsits), we must collect a percentage of our whatsit sales income as a **sales tax** and send it to the State Tax Collector every three months (i.e., - quarterly). It is VERY IMPORTANT to keep accurate records of our total monthly revenue in order to compute the correct amount of tax to pay. If we fail to do this, we will be subject to a substantial penalty.

EXERCISES:

1. The sales tax in the state where our business is located is 4%. Find the amount of sales tax that our business must collect and pay to the state based on the given revenue for a three-month period.

a)	Revenue
Month 1	$8000
Month 2	$5000
Month 3	$7000
Total rev.	
Amt. of tax	______

b)	Revenue
Month 1	$12000
Month 2	$9000
Month 3	$11500
Total rev.	
Amt. of tax	______

c)	Revenue
Month 1	$6500
Month 2	$11200
Month 3	$9050
Total rev.	
Amt. of tax	______

d)	Revenue
Month 1	$7500
Month 2	$3600
Month 3	$9300
Total rev.	
Amt. of tax	______

e)

	Revenue
Month 1	$8670
Month 2	$12400
Month 3	$13240
Total rev.	

Amt. of tax ____________

f)

	Revenue
Month 1	$11425
Month 2	$6455
Month 3	$8425
Total rev.	

Amt. of tax ____________

g)

	Revenue
Month 1	$11423
Month 2	$12463
Month 3	$14231
Total rev.	

Amt. of tax ____________

h)

	Revenue
Month 1	
Month 2	
Month 3	
Total rev.	

Amt. of tax ____________

SALES TAX
ANSWERS TO LABORATORY EXERCISES

As a retailer (of whatsits), we must collect a percentage of our whatsit sales income as a **sales tax** and send it to the State Tax Collector every three months (i.e., - quarterly). It is VERY IMPORTANT to keep accurate records of our total monthly revenue in order to compute the correct amount of tax to pay. If we fail to do this, we will be subject to a substantial penalty.

EXERCISES:

1. The sales tax in the state where our business is located is 4%. Find the amount of sales tax that our business must collect and pay to the state based on the given revenue for a three-month period.

a)	Revenue
Month 1	$8000
Month 2	$5000
Month 3	$7000
Total rev.	$20,000
Amt. of tax	$800

b)	Revenue
Month 1	$12000
Month 2	$9000
Month 3	$11500
Total rev.	$32,500
Amt. of tax	$1300

c)	Revenue
Month 1	$6500
Month 2	$11200
Month 3	$9050
Total rev.	$26,750
Amt. of tax	$1070

d)	Revenue
Month 1	$7500
Month 2	$3600
Month 3	$9300
Total rev.	$20,400
Amt. of tax	$816

e)

	Revenue
Month 1	$8670
Month 2	$12400
Month 3	$13240
Total rev.	$34,310
Amt. of tax	$1372.40

f)

	Revenue
Month 1	$11425
Month 2	$6455
Month 3	$8425
Total rev.	$26,305
Amt. of tax	$1052.20

g)

	Revenue
Month 1	$11423
Month 2	$12463
Month 3	$14231
Total rev.	$38,117
Amt. of tax	$1524.68

h)

	Revenue
Month 1	
Month 2	
Month 3	
Total rev.	
Amt. of tax	

SALES TAX
HOMEWORK EXERCISES

1. Use the monthly revenue data given. Find the amount of quarterly sales tax due for the given tax rate.

a)

	Revenue
Month 1	$7500
Month 2	$8700
Month 3	$6600

Total rev.
Tax rate: 4%

Amt. of tax ____________

b)

	Revenue
Month 1	$10000
Month 2	$8400
Month 3	$6800

Total rev.
Tax rate: 5%

Amt. of tax ____________

c)

	Revenue
Month 1	$13000
Month 2	$9500
Month 3	$12050

Total rev.
Tax rate: 6%

Amt. of tax ____________

d)

	Revenue
Month 1	$14500
Month 2	$11075
Month 3	$10225

Total rev.
Tax rate: 7.5%

Amt. of tax ____________

e)

	Revenue
Month 1	$14500
Month 2	$9400
Month 3	$7600

Total rev.
Tax rate: 4%

Amt. of tax ____________

f)

	Revenue
Month 1	$6050
Month 2	$4075
Month 3	$6875

Total rev.
Tax rate: 5.5%

Amt. of tax ____________

SALES TAX
ANSWERS TO HOMEWORK EXERCISES

1. Use the monthly revenue data given. Find the amount of quarterly sales tax due for the given tax rate.

a)

	Revenue
Month 1	$7500
Month 2	$8700
Month 3	$6600

Total rev. $22,800
Tax rate: 4%

Amt. of tax $912

b)

	Revenue
Month 1	$10000
Month 2	$8400
Month 3	$6800

Total rev. $25,200
Tax rate: 5%

Amt. of tax $1260

c)

	Revenue
Month 1	$13000
Month 2	$9500
Month 3	$12050

Total rev. $34,550
Tax rate: 6%

Amt. of tax $2073

d)

	Revenue
Month 1	$14500
Month 2	$11075
Month 3	$10225

Total rev. $35,800
Tax rate: 7.5%

Amt. of tax $2685

e)

	Revenue
Month 1	$14500
Month 2	$9400
Month 3	$7600

Total rev. $31,500
Tax rate: 4%

$1260

f)

	Revenue
Month 1	$6050
Month 2	$4075
Month 3	$6875

Total rev. $17,000
Tax rate: 5.5%

$935

COMPUTER SOFTWARE ACTIVITY LESSON PLAN

TOPIC: RUNNING THE SIMULATION

OBJECTIVES:

to provide an experience in simulating the running of a business

to illustrate the use of mathematics in making decisions and finding solutions

to provide practice in calculating, estimating, and record-keeping

to develop general problem solving skills such as planning ahead, working in two time frames, and evaluating/modifying strategies

COURSES: General, Business, Consumer, Career Math
7th and 8th grade math

SOFTWARE NEEDED: The Whatsit Corporation

SUGGESTED TIME:

one class period for the demonstration
two class periods for the student run of the simulation

PREREQUISITE SKILLS/CONCEPTS:

evaluate a one-variable arithmetic formula
find a percent of a number
given a whatsit sales formula, set an appropriate price
calculate the effect of advertising on sales

GENERAL DESCRIPTION OF THE LAB ACTIVITY

The following procedure is suggested so that the activity can proceed smoothly and still allow time for the teacher to give a substantial amount of supervision.

Day 1 Run the simulation program as a demonstration. Lead the class through the simulation step by step -- discussing the decision-making processes and completing the record-keeping necessary to be successful. Follow the instructions on the Laboratory Demonstration Teacher's Guide sheet.

Day 2 Create small business teams of three or four students per computer. Have the student teams run the simulation. Give each team either of the following sets of forms. The first set provides a simple, complete method of record-keeping for student teams. The second set is found in the Sunburst Manual, and, although not as easy to use, provides a more realistic record-keeping experience.

Either WHATSIT CORPORATION INFORMATION SHEET (1,attached)
WHATSIT INVENTORY SHEET (1,attached)
CASH BALANCE RECORD (1,attached)
INCOME STATEMENT (1,Worksheet #6,Sunburst Manual)
BALANCE SHEET (1,Worksheet #7,Sunburst Manual)

or GENERAL INFORMATION (1,Worksheet #1,SunburstManual)
START-UP COSTS (1,Worksheet #2,Sunburst Manual) (1)
CASH ACCOUNTS (6,Worksheet #3,Sunburst Manual) (6)
INVENTORY RECORD (3,Worksheet #4,Sunburst Manual)
SALES RECORD (2,Worksheet #5,Sunburst Manual)
INCOME STATEMENT (1,Worksheet #6,Sunburst Manual)
BALANCE SHEET (1,Worksheet #7,Sunburst Manual)

Also give each student a copy of the "Suggestions" (attached). These hints and pointers can help teams avoid committing the most common errors.

Once the students have been prepared for their task, the teacher's role is that of facilitator and troubleshooter.

Since a second class period will be required to complete the activity, have students save their simulations. The program can be saved by selecting #7 at the Weekly Decisions menu. (It cannot be saved at the Monthly Decisions menu!)

RUNNING THE SIMULATION
LABORATORY DEMONSTRATION
TEACHER'S GUIDE

DIRECTIONS:

1. Boot the program disk. Enter your name when prompted. Answer NO when asked if this is a continuation of a previous simulation. (This option is used to rerun a previously saved simulation.)

2. Begin a Cash Balance Record. Start with a preliminary total of $10000.

3. At the Preliminary Choices Menu:

   a. Select (1) Community Survey. Pay the $1500 fee and record the results of the survey. Subtract the fee from your cash balance.

   b. Select (4) Take Out Loan. Take out a loan of $10000. Add this amount to your cash balance.

   c. Select (3) Buy a Franchise. Purchase a franchise consistent with the information you got from the community survey. Deduct the purchase price from your cash balance.

   d. Select (2) Hire Economist. Pay the $2000 fee and record all information on the Information Sheet provided. Deduct the $2000 from your cash balance. Have the students calculate optimal prices in good, moderate, and poor markets. (To save time, break the class into thirds and have each group calculate the optimal price in one of the three markets.)

   e. Select (5) Visit the Vice President. Record the information the V.P. gives you on the Information Sheet.

   f. Select (6) Open for Business

4. Record the economic forecast found on the Micro Street Journal. Note the prime rate.

5. At the Monthly Decision menu:

   a. Select (4) Order Inventory. Purchase 800 whatsits. Record this number on the Whatsit Inventory Sheet.

   b. Select (3) Hire or Lay Off Salespeople. Hire 3.

   c. Select (7) Continue.

6. At the Weekly Decision menu:
   - a. Select (3) Set Price. Set a price consistent with the economist's sales formulas, the optimal prices found in Step 3d above, and the economic forecast in Step 4.
   - b. Select (6) Continue.
7. Use the weekly report. Record and subtract the number of whatsits sold or missing from the total on the Whatsit Inventory Sheet.
8. Make adjustments to the price in the subsequent weeks. If sales are too low, lower the price or advertise (#2 on the Weekly Decision menu). If sales are too high, raise the price, or stop advertising. (If sales are too high, you'll run out of inventory before the end of the month.)
9. Continue this process to the end of the first month.
10. At the Monthly Report, use Worksheet 6:
    - a. Record the total revenue.
    - b. Record all expenses.
    - c. Add the expenses and record the result next to Total Expenses.
    - d. Subtract the Total Expenses from the Total Revenue and record the profit or loss.
    - e. Add the profit or subtract the loss from the cash balance.
11. As time permits, begin the second month (at Step 4) and continue..... then third month....

SIMULATION CHOICES ... SOME SUGGESTIONS

1. In the long run, the information provided by the community survey is well worth the $1500 fee. Without this information the chances are great that your franchise will not be well suited to its location.

2. Hire the economist. Such professional information is well worth the $2000 fee.

3. At the monthly decision menu, order as much of your whatsit inventory as possible. This is the cheapest and easiest way to obtain whatsits to sell. Ordering inventory at the weekly menu (rush ordering) is expensive and highly restrictive.

4. Although it is expensive to store extra whatsits (10 cents per whatsit per week), consider keeping a number in reserve in case of an emergency (late deliveries or supplier shortages).

5. Don't hire too many salespersons at the beginning of the simulation. There are costs associated with laying off employees.

6. Keep very accurate records of your monthly total revenue Every three months you will be required to pay 4% of your total monthly revenue, and there are substantial penalties for underpayment.

THE WHATSIT CORPORATION
INFORMATION SHEET

Community Survey: Type of Community____________________________
Recommended Whatsit Franchise________________

Economist Information: **Sales Formulas**
Good Market______________________
Moderate Market ____________________
Poor Market _______________________

Sales Information

	Good	Moderate	Poor
Manager Alone			
Manager + 1			
Manager + 2			
Manager + 3			
Manager + 4			

Other Information

Inventory Costs ______________

Fixed Costs ______________

Average Whatsit Cost ______________

Manager's Salary ______________

Salesperson's Salary ______________

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p. 167

Whatsit Inventory Sheet

Add	Subtract	Total Whatsits
Additional Inventory	Sales/ Missing	

Add	Subtract	Total Whatsits
Additional Inventory	Sales/ Missing	

pimms p. 168

CASH BALANCE RECORD

Add Loans and Profits	Subtract Expenses and Loses	Cash Balance	
		$10,000.00	Preliminary Total

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191 p. 169

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PROJECT TO INCREASE MASTERY OF MATHEMATICS AND SCIENCE

Computer Software Demonstration

A PIMMS MATHEMATICS AWARENESS WORKSHOP

Place: Date:

Target audience: Secondary mathematics teachers and department heads Maximum: 30

Presenters: Nancy Cetorelli, Stratford; Don Hastings, Monroe H.S.; Geo. Parker, E.O. Smith H.S., Storrs

Content and Purpose: Computer technology is having a great impact upon mathematics education. For example, the rapid generation of images can be used to convey concepts visually and thereby provide more classroom time for analysis and conjecture-testing. In this workshop we will demonstrate the use of exemplary commercial software that can enhance teaching towards specific mathematical objectives. The software packages include the Geometric preSupposer, Supposer, Superplot, Green Globs/Graphing Equations, and selected programs from the MECC series. Programs dealing with spatial visualization and general math also will be demonstrated. Computer ethics and classroom management will be addressed. All software currently used is Apple-based.

Time: Refreshments will be available at 3:30 p.m. The workshop runs from 4 p.m. to 8 p.m. with a break for a meal at about 6 p.m.

Cost: (approx.) A registration fee of $ 33 contributes to the direct costs of the workshop. In addition, $ 5 of printed materials will be issued. Please make the check in the amount of $ 38 per participant payable to PIMMS.

Contact: Send your check and registration form **FOR OUR RECEIPT BY**
to
(varies with location of the workshop)

Districts or Regional Centers wishing to host a Workshop should contact the **pimms** office (347-9411 x2688). Desirable hardware for mounting a workshop: 1 computer per two participants, 1 printer with graphics capability, at least one color monitor; overhead projector with screen, small chalkboard.

pimms Curriculum Development Publications

- * Apple Microcomputer Software Evaluation, August 1985; 14 pp. (free)

- * A Review of Selected Microcomputer Software Packages with Lessons for Teaching Mathematics, Grades 8 - 12, Vol. 1, April 1987; 122 pp. $4.50

- * A Review of Selected Microcomputer Software Packages with Lessons for Teaching Mathematics, Grades 8 - 12, Vol. 2, **April 1988**; 170 pp. $6
  [Also available on a single 5.25" disk (Appleworks/ProDOS), $6.]

- * A Guide to Curriculum Development in Applied Mathematics: A Three-year Sequence for Noncollege Bound Students (Vol. 1 of 3, preliminary edition), Fall 1986; 82 pp. $3.25

- * Down to Earth Chemistry, (for the non-college-bound), 3 sample units, February 1987; 60 pp. (free)

- * Down to Earth Chemistry, (for the non-college-bound), **April 1988**; 337 pp. $10
  [Also available on two 5.25 " disks (Applewriter II/ProDOS), $10.]

- * A Guide to Computer Use by the Science Teacher, October 1987 c.; 70 pp. $3
  [Also available on a single 5.25" disk (Applewriter II/ProDOS), $3.]

- * Microcomputer Activities for the Teaching of Science and Thinking Skills in the Elementary School, Grades 3 - 7, **April 1988**; 42 pp. $ 3
  [Also available on a single 3.5" disk (MacWrite 4.5), $3.]